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PPRP

ENVIRONMENTAL RADIONUCLIDE CONCENTRATIONS IN THE VICINITY OF THE PEACH BOTTOM ATOMIC POWER STATION: 1991-1994

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MARYLAND POWER PLANT RESEARCH PROGRAM

STATE OF MARYLAND DEPARTMENT OF NATURAL RESOURCES

The Maryland Department of Natural Resources (DNR) seeks to preserve, protect and enhance the living resources of the State. Working in partnership with the citizens of Maryland, this worthwhile goal will become a reality. This publication provides information that will increase your understanding of how DNR strives to reach that goal through its many diverse programs.

John R. Griffin
Secretary
Maryland Department of Natural Resources

PPRP-R-21

ENVIRONMENTAL RADIONUCLIDE CONCENTRATIONS IN THE VICINITY OF THE PEACH BOTTOM ATOMIC POWER STATION: 1991-1994

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FOREWORD

This report, *Environmental Radionuclide Concentrations in the Vicinity of the Peach Bottom Atomic Power Station: 1991-1994*, contains the results of monitoring and research programs conducted by the Maryland Department of Natural Resources, Power Plant Research Program, to evaluate the fate and effects of radionuclides released from the Peach Bottom Atomic Power Station from 1991 through 1994. This is the fifth in a series of radiological assessment reports detailing monitoring efforts in the vicinity of the Peach Bottom Atomic Power Station since 1979. This report was prepared under Contract Numbers PR91-047-001 and PR96-055-001 with the Maryland Department of Natural Resources, Power Plant Research Program to Versar, Inc.

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ABSTRACT

The Maryland Power Plant Research Program monitors concentrations of natural, weapons, and power plant produced radionuclides in environmental samples collected from the Susquehanna River-Chesapeake Bay system in the vicinity of Peach Bottom Atomic Power Station (PBAPS). The purpose of this monitoring is to determine the fate, transport, and potential effects of power plant produced radionuclides. This report contains a description of monitoring activities and data collected during the period 1991 through 1994 and is the fifth in a series reporting monitoring results initiated at PBAPS in 1979.

Radionuclides released from PBAPS were reported by the Philadelphia Electric Company (PECO). All releases during the reporting period were as a result of normal plant operations and no releases exceeded limits set by the U.S. Nuclear Regulatory Commission (USNRC).

Radionuclide concentrations in finfish, aquatic vegetation, and sediment were measured using high-resolution gamma spectrometry. Radionuclides in environmental samples originated from natural sources, atmospheric weapons testing, and normal operations of PBAPS. Naturally occurring ^{40}K and decay products of uranium and thorium were detected in most biota and all sediment samples collected during the monitoring period. Concentrations of naturally occurring radionuclides were typically almost an order of magnitude higher than plant-produced radionuclides. Cesium-137 was the only radionuclide related to fallout from weapons testing detected in environmental samples collected from 1991 to 1994.

Small concentrations of radionuclides originating from PBAPS were detected in many of the biota and sediment samples collected in the vicinity of the plant. Commonly detected radionuclides included ^{137}Cs, ^{60}Co, and ^{65}Zn. Finfish from the Conowingo Pond contained the highest radionuclide concentrations detected in biota. The principal PBAPS-related radionuclides in sediments were ^{60}Co and ^{65}Zn. PBAPS-related radionuclides represented a small fraction of the total concentration of radionuclides detected in the sediments and biota collected within the Susquehanna River-Chesapeake Bay system. Total concentrations of radionuclides detected in sediment and biota did not exceed any USNRC action levels.

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ACRONYMS, CHEMICAL ABBREVIATIONS, AND UNITS OF MEASUREMENT

ACRONYMS

BGE	-	Baltimore Gas and Electric Company
BWR	-	Boiling Water Reactor
DNR	-	Maryland Department of Natural Resources
GPUN	-	General Public Utility Nuclear Corporation
LLD	-	Lower Limit of Detection
MDE	-	Maryland Department of the Environment
NCRPM	-	National Council on Radiation Protection and Measurements
PBAPS	-	Peach Bottom Atomic Power Station
PECO	-	Philadelphia Electric Company
PPRP	-	Power Plant Research Program
USAEC	-	United States Atomic Energy Commission
USEPA	-	United States Environmental Protection Agency
USGS	-	United States Geological Survey
USNRC	-	United States Nuclear Regulatory Commission

CHEMICALS

Ag	silver
Ac	actinium
Be	beryllium
Bi	bismuth
C	carbon
Ce	cerium
Co	cobalt
Cr	chromium
Cs	cesium
Cu	copper
Fe	iron
Ge	germanium
H	hydrogen
^3H	tritium
I	iodine
K	potassium
La	lanthanum
Li	lithium
Na	sodium
Nb	niobium
P	phosphorus
Pb	lead
Ra	radium
Ru	ruthenium
Sb	antimony
Se	selenium
Sr	strontium
Th	thorium
Tl	thallium
U	uranium
Xe	xenon
Zn	zinc
Zr	zirconium

UNITS OF MEASUREMENT

Ci	curies
cm	centimeters
dpm	disintegrations per minute
ft^3/s	cubic feet per second
ha	hectares
keV	thousand electron volts
kg	kilograms
km	kilometers
l	liters
m	meters
m^3/s	cubic meters per second
mi^2	square miles
min	minutes
mm	millimeters
mrem	millirem
pCi	picocuries
ppm	parts per million
yr	year

RADIOLOGICAL DEFINITIONS

Activity. The quantification of the rate of radioactive decay of radioactive material.

Becquerel. A unit of radioactivity. One becquerel is defined as 1 disintegration per second.

Curie (Ci). A unit of radioactivity. One curie is defined as 3.7×10^{10} disintegrations per second.

Dose. The energy imparted to matter by ionizing radiation. The unit of absorbed dose is the rad, equal to 0.01 joules per kilogram for irradiated material in any medium.

Dose commitment. The dose that an organ or tissue would receive during a specified period of time (e.g., a 50-year period is used in dose calculations in this report) as a result of intake (as by ingestion or inhalation) of one or more radionuclides from one year's release.

Environmentally significant. As used in this report, refers to radionuclides that are known to be assimilated by biological organisms and are discharged in detectable amounts. Not included are aqueous release of noble gases, tritium, or very short-lived radionuclides.

Half-life. The time required for a radioactive substance to lose one-half of its activity by decay. Each radionuclide has a unique half-life.

Ionizing radiation. Any electromagnetic or particulate radiation capable of producing ions (electrically charged atoms or atomic particles), directly or indirectly, in its passage through matter.

Maximally exposed individual. A hypothetical individual who remains in an uncontrolled area and would, when all potential routes of exposure from a facility's operations are considered, receive the greatest possible dose.

Radioactive decay. The spontaneous transformation of one nuclide into a different radioactive or nonradioactive nuclide, or into a different energy state of the same nuclide.

Radionuclide. An unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

Rem. The effective dose equivalent (i.e. the absorbed dose multiplied by the quality factor associated with the type of radiation).

Stable. Not radioactive or not easily decomposed or otherwise modified chemically.

1.0 INTRODUCTION

The Peach Bottom Atomic Power Station (PBAPS) generates both gaseous and liquid radioactive wastes that are discharged to the atmosphere and the lower Susquehanna River. Although atmospheric releases consist mainly of radioactive noble gases, which have little environmental significance, aqueous discharges to the lower Susquehanna River contain radionuclides that can be accumulated by biota and become associated with sediments. These radionuclides ultimately may contribute to a radiation dose to man by being transported through the food chain.

This report examines and summarizes the results of monitoring and research programs conducted in the lower Susquehanna River and upper Chesapeake Bay from 1991 through 1994 by the Maryland Power Plant Research Program (PPRP). The report includes

- a summary of radionuclide releases from PBAPS to the lower Susquehanna River;
- descriptions of procedures for collecting, treating, and analyzing environmental samples;
- radionuclide concentrations measured in more than 250 samples of aquatic vegetation, finfish, and sediment collected from the lower Susquehanna River and upper Chesapeake Bay; and
- an assessment of the environmental and health-related effects of radioactive discharges from PBAPS detected in the Susquehanna River-Chesapeake Bay system.

1.1 MONITORING OBJECTIVES

The Power Plant Research Program (PPRP) of the Maryland Department of Natural Resources (DNR) has conducted research and monitoring since 1979 to assess the effects of radioactive material released from PBAPS on Maryland's ecological resources. These programs evaluate radiological effects within individual trophic levels of the Susquehanna River-Chesapeake Bay ecosystem and provide information concerning the behavior and fate of radionuclides released to Susquehanna River and upper Chesapeake Bay. These monitoring data are also used to estimate the radiological dose to human populations resulting from the discharge of radionuclides from power plants.

Radionuclide monitoring conducted by PPRP primarily focuses on discharges to water and transfers within aqueous pathways; however, atmospheric releases of radioactive material are also assessed using data collected by PECO and Maryland Department of the Environment (MDE). The results of these assessments are published biannually (Maranto and McLean 1993, Stanek and McLean 1995b).

1.2 DESCRIPTION OF PLANT AND STUDY SITE

The Philadelphia Electric Company (PECO) owns and operates PBAPS. The plant is in York County, Pennsylvania, approximately three miles north of the Pennsylvania-Maryland border, on the western shore of Conowingo Pond (Figure 1-1). Each of PBAPS's two units is a boiling water reactor (BWR) with a capacity of 1098 megawatts. Controlled releases of radionuclides are permitted at levels defined in PBAPS's license issued October 25, 1973 for Unit 2 and July 2, 1974 for Unit 3 from the United States Nuclear Regulatory Commission (USNRC 10 CFR Part 20, Appendix B, 1991). The plant began operations in 1974. On March 31, 1987, the USNRC ordered PECO to cease operations at PBAPS due to concerns about standards of performance and management oversight and accountability. The USNRC allowed PBAPS to resume operations on April 17, 1989.

PECO withdraws cooling water for PBAPS from the portion of the Susquehanna River known as Conowingo Pond at an average rate of about 625,000 gal/min (PBAPS Communications Office). Conowingo Pond also receives aqueous radionuclides discharged from the plant during normal operations. Conowingo Pond is an impoundment created by the Conowingo hydroelectric dam (13 km downstream from PBAPS) and the Holtwood Dam (10 km upstream of PBAPS). It has an average surface area of approximately 3700 ha (14 mi^2) and ranges in depth from about 3 m in upriver sections to a maximum of about 27 m at the face of the Conowingo Dam. The annual average river flow at the dam is approximately 1000 m^3/s (35,000 ft^3/s). Downriver flow may be perturbed by withdrawal and discharge of cooling water for PBAPS, periodic cycling of water at the Muddy Run Pumped Storage Facility on the eastern shore, and operation of the turbines at the Conowingo Dam.

The Susquehanna River enters the tidal portion of the Chesapeake Bay approximately 6 km downstream from the Conowingo Dam. The location of the resulting interface between fresh and salt water fluctuates at the river mouth (Susquehanna Flats) or the upper Chesapeake Bay and is controlled principally by river volume. The transition from fresh to brackish water is accompanied by changes in physical and chemical factors that affect the degree to which metals and radionuclides become or remain associated with particles suspended in the water column (Olsen et al. 1989). These factors influence the dispersion and distribution of radionuclides in the Susquehanna-Chesapeake Bay system.

The Susquehanna-Chesapeake Bay system supports an abundant and diverse macrobenthic assemblage and recreationally and commercially important finfish (Martin Marietta 1985). Conowingo Pond contains largemouth and smallmouth bass, walleye, sunfish, channel catfish, and hybrids of white and striped bass. These species are the principal components of the recreational fishery below the Conowingo Dam. Further downstream, white perch, channel catfish, and American eels are commercially fished on the Susquehanna Flats.

The Susquehanna Flats area supports seasonal stands of submerged aquatic vegetation (SAV), primarily Eurasian milfoil (*Myriophyllum spictum*), and is an important early wintering ground for migratory waterfowl (Lippson 1973). Blue crabs and oysters are important components of recreational and commercial fisheries farther down bay.

1.3 RADIATION PROTECTION GOALS AND HEALTH PHYSICS

The ultimate goal of PPRP monitoring is to determine what effect, if any, the operation of the power plant, and its consequent effluent discharges, have on the environment. For the purpose of this report, the principal effect to be assessed is the increased radiological dose to ecological and human receptors resulting from power plant operation and the discharge of radionuclides. To assess relative importance, this increased dose needs to be compared to natural dose estimates; therefore, the following section will provide information on natural background radiation. This information is focused on human exposure because more information is available for human exposure compared to what is available for ecological exposure. Past tasks of the PPRP radionuclide monitoring program have included the examination of these pathways in order that all of the possible routes to man are taken into account.

1.3.1 Background Radiation

Radioactive isotopes occur naturally and exist everywhere in the environment (Table 1-1). The average radiation dose to man resulting from naturally occurring radionuclides is approximately 300 mrem/year or about 80% of the total dose man is likely to receive in a year. Principal sources of radiation to man include the following:

- Terrestrial sources of radiation come from naturally occurring primordial (i.e. present in the earth's crust since the time of the earth's creation) radionuclides such as ^{40}K and the Thorium and Uranium elements. These radionuclides typically have very-long half-lives, some exceeding several million years.

- Cosmic radiation includes cosmic rays, which originate outside of our galaxy, and the radiation resulting from the production of cosmogenic radionuclides in the upper atmosphere from cosmic ray interactions with atmospheric gases.

- Radionuclides in the body exist as a result of the ingestion of food and water which contain trace quantities of primordial radionuclides.

- Inhaled radionuclides are a result of inhalation of primordial radionuclides which have been transferred to the atmosphere. The primary target organ is the lungs.

- Consumer products include tobacco products, building materials, television sets, radioluminescent watches, airport inspection systems, smoke detectors, lantern mantels, etc.

Table 1-1. Sources of Natural/Background Radiation (average for U.S. population). Source: NCRPM 1987, 1988.

	Average Annual Effective Dose Equivalent (mrem/yr)
Naturally Occurring	
External terrestrial	28
Cosmic	27
Radionuclides in the body (i.e., ^{40}K, ^{226}Ra)	40
Inhaled radionuclides (i.e. ^{222}Rn)	200
Medical	
Diagnostic X-rays	39
Therapeutic X-rays	< 1
Nuclear medicine	14
Consumer Products	6-12
Other	
Fallout	< 1
Nuclear Fuel Cycle	< 1
Occupational	< 1
Miscellaneous	< 1
Rounded Total:	360

1.3.2 Quantities and Units

The traditional and most common units of measure of radioactivity in the United States, and its effects are the curie and the rem (see glossary); however, these units have been replaced by the becquerel and the sievert, respectively, to conform to standard international unit convention.

The quantity of radioactive material which is decaying, or the rate of decay, is given in units of **curies**. Typically, environmental samples contain radioactive material at the picocurie level (10^{-9} curie). One picocurie of radioactive material is equivalent to a decay rate of 0.037 disintegrations of individual atoms per minute. Each disintegration (or transformation) produces one or more of several different types of radiation (alpha, beta, or gamma) of varying intensities.

Radiological dose units are typically expressed in units of **rem** (effective dose equivalent; Table 1-2). Adverse biological effects on man are more likely to occur at higher effective dose equivalents where non-stochastic effects (cell death) and stochastic effects (cancer) can occur.

Table 1-2. Determination of the effective dose equivalent.

The effective dose equivalent to man in mrem (for gamma rays) is given by:

$$H_E = \sum \frac{970\ w_T A \Gamma Q}{d_T^2}$$

where

- w_T = weighting factor representing the proportion of the stochastic risk resulting from tissue T.
- A = point source activity in becquerels.
- Γ = specific gamma-ray constant for the source radionuclide.
- d_T = distance from the source (assuming a point source) to the point at which the exposure rate is calculated (cm).
- Q = quality factor based on the type of radiation (Q=1 for gamma-rays).

1.3.3 Protection Levels and Goals

The promulgated maximum annual effective dose equivalent to the general population as a result of licensee's activities involving the use of radioactive material is 100 mrem above background levels, exclusive of the dose contribution from the licensee's disposal of radioactive material (USNRC 1991). Dose limits for radioactive material in liquid effluents are more restrictive:

> "The dose or dose commitment to a member of the public from radioactive materials in liquid effluents released to unrestricted areas shall be limited: A) During the calendar quarter to less than or equal to 3.0 mrem to the total body and to less than or equal to 10 mrem to any organ, and B) During any calendar year to less than or equal to 6 mrem to the total body and to less than or equal to 20 mrem to any organ."

Therefore, this report will verify that the quantities of radionuclides found in sediment and biota do not pose a threat to human health as measured by their consequent effective dose equivalent as they migrate through trophic layers to man.

2.0 METHODS AND MATERIALS

2.1 SAMPLE COLLECTION

The scope of the PPRP radionuclide monitoring effort was scaled back during the 1991 to 1994 monitoring period. The program emphasis shifted from an examination of transfer between several trophic layers in a variety of biological samples to direct transfer between two trophic levels (fish and humans). The mussel and crayfish study was discontinued in 1991 after it was determined that the study of these organisms was no longer required to accomplish PPRP monitoring goals. These organisms were found to bioconcentrate certain radionuclides (Stanek and McLean 1995a, Domotor and McLean 1989, McLean and Domotor 1988) creating the potential for trophic transfer; however, reduced radionuclide emissions from PBAPS led to a pronounced reduction in radionuclide detection in these organisms thereby decreasing their effectiveness as a biological indicator of radionuclide presence in the food chain. Collection of finfish, however, continued due to their tendency to accumulate and bioconcentrate radionuclides discharged from PBAPS and because finfish represent a direct source to man of plant produced radionuclides.

Table 2-1 lists the environmental samples collected from the Conowingo Pond, Susquehanna Flats, and upper Chesapeake Bay for radiological analysis. Figure 2-1 presents the Susquehanna River-Chesapeake Bay study area and sampling sites for monitoring releases from PBAPS.

Table 2-1. Environmental samples for radiological analysis collected from the lower Susquehanna River and upper Chesapeake Bay, 1991-1994

Sample Media	Collection Frequency	Number of Sampling Locations	Description of Sampling Locations
Sediments	Spring and Fall	19	Conowingo Pond (12 stations); Susquehanna Flats (6 stations); upper Chesapeake Bay (1 station)
Forage finfish	Spring and Fall	3	Conowingo Pond (on the western shore down-stream of the PBAPS discharge at station LYH-1*; Susquehanna Flats (2 km from the river mouth)
Edible finfish	Spring and Fall	3	Conowingo Pond (LYH-1)*; Conowingo Dam (from the tailrace fishlift)
SAV	Spring and Fall	3	Susquehanna River (on the shores below the Rt. 95 bridge); Susquehanna Flats

* LYH = Little Yellow House.

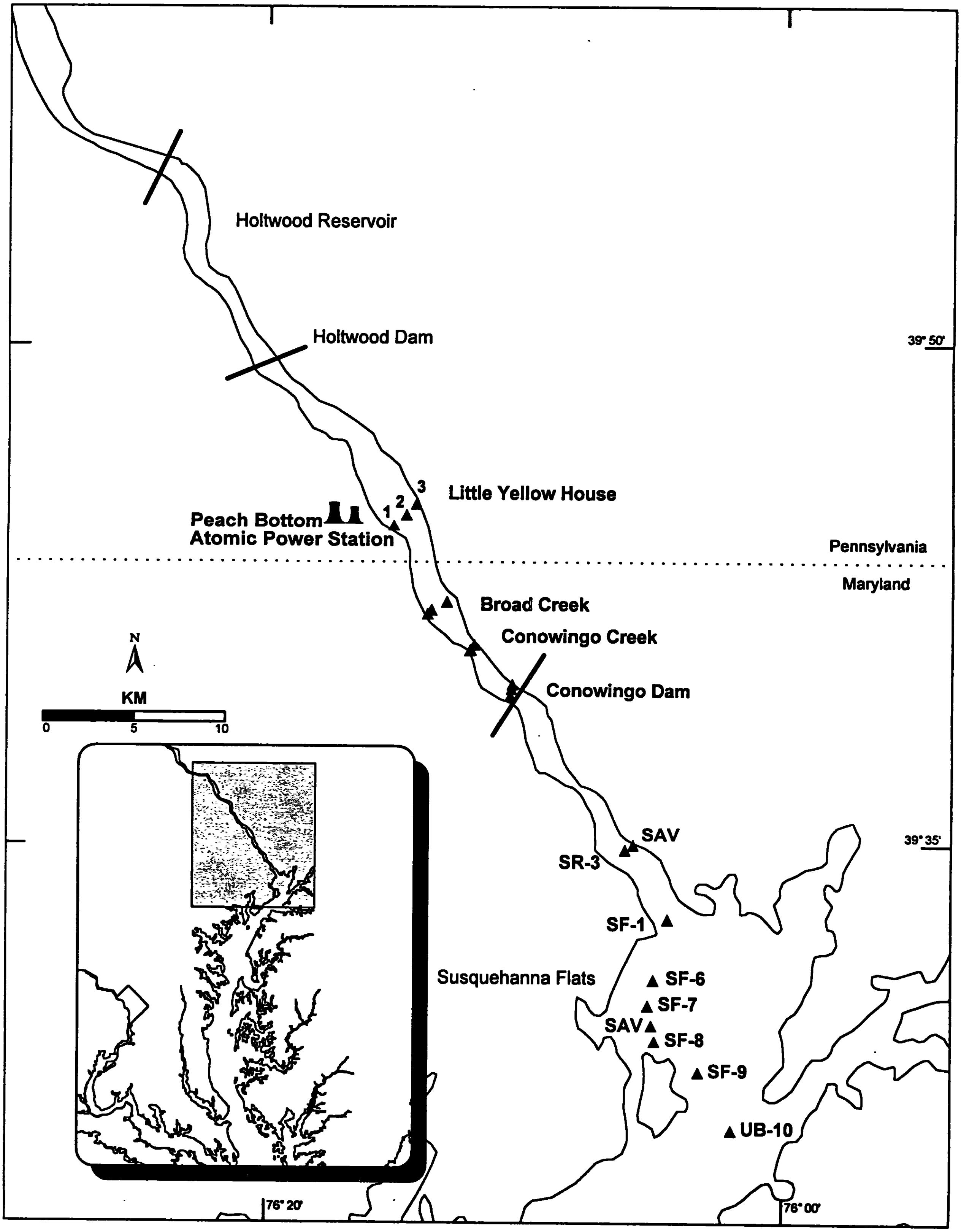

Figure 2-1. Transects and stations for samples collected from the lower Susquehanna River and upper Chesapeake Bay. Appendix C contains a list of coordinates for all stations.

2.1.1 Sediments

Sediments were collected semi-annually (spring and fall) from a grid of transects in the Conowingo Pond and downstream at the Susquehanna Flats and upper Chesapeake Bay (Figure 2-1). All sediments were collected using a hand-operated, mechanical box grab. The top 10 cm (or less) of sediment was recovered from each grab until approximately 3 liters of sediment was collected at each station.

2.1.2 Biota

Biota collected for radiological analysis included forage finfish, recreationally and commercially important finfish, and SAV. Edible finfish were collected by electrofishing or by hook and line; forage finfish were collected by beach seine (6- or 8-mm mesh). Finfish were sampled regardless of size. Finfish from below the Conowingo Dam were collected from the tailrace fishlift. SAV was collected by removing the sample from the water by hand.

2.2 MEASUREMENT OF GAMMA-EMITTING RADIONUCLIDES IN BIOTA AND SEDIMENTS

2.2.1 Sample Preparation

Sediment samples were inspected visually, placed in a 2-liter Marinelli beaker and analyzed for radionuclide content using gamma spectrometry. After counting, drying, and weighing, sediment samples were analyzed for particle size (Section 2.3) to determine their composition (i.e., sand, silt, or clay).

Biological samples were prepared for analysis as follows:

<u>Edible finfish flesh and forage finfish:</u> Samples were diced into 3-cm cubes and packed to a volume of 1 or 2 liters and preserved in a 10% formaldehyde solution.

<u>Edible finfish gut:</u> Samples were wet-digested in nitric acid and diluted to 1 or 2 liters with deionized water.

<u>Submerged aquatic vegetation:</u> Samples were packed to a volume of 1 or 2 liters and preserved in a 10% solution of formaldehyde.

Some forage finfish (e.g., shiners and silversides) and juveniles of other species (e.g., sunfish and gizzard shad) are important food sources for predatory finfish (e.g., smallmouth and largemouth bass, and striped bass) that are consumed by man. These forage fish were analyzed whole (i.e., viscera and bone were not removed) to detect radioactivity that could be transferred through the food chain and potentially contribute to a radiation dose to man. Edible finfish were filleted, and samples of flesh and gut were analyzed for gamma-emitting radionuclides.

2.2.2 Gamma Spectrometry

During 1991 through 1993, the gamma-ray counting system consisted of two high-resolution germanium-lithium [Ge(Li)] coaxial detectors and one intrinsic (high-purity) germanium [HPGe] coaxial detector coupled to a 4096-channel ND9900 pulse-height analysis system (Nuclear Data, Inc., Schaumburg, IL). The germanium-lithium detectors, manufactured by Ortec (Ortec, Inc., Oak Ridge, TN) and Princeton Gamma-Tech (Princeton Gamma-Tech, Princeton, NJ) were 13% and 16% efficient respectively. The intrinsic germanium detector was manufactured by Ortec and was 25% efficient. During 1994, the counting system employed two intrinsic germanium detectors, one each manufactured by Ortec and Canberra (Canberra, Inc., Meriden, CT). The detectors were 25% and 23% efficient respectively.

Files containing appropriate energy calibrations, nuclide libraries, and geometries and counting efficiencies by sample were used to produce reports of sample activity. Gamma-ray energies for peak regions of interest were taken from Heath (1977) and Smith and Wollenberg (1972). Calculations used in nuclide libraries employed gamma-ray intensity values compiled by Heath (1977), Kocher (1977), and Smith and Wollenberg (1972).

During 1991 through 1993, counting efficiencies for the various geometries and kinds of samples were determined by internal spiking with radionuclide standards of wide energy range. The standards, which were supplied by the U.S. Environmental Protection Agency, were traceable to standards maintained by the National Institute of Standards and Technology (NIST). During 1994, counting efficiencies were determined using custom multi-gamma standards commercially purchased from Analytics, Inc., Atlanta, GA, which were traceable to NIST. All spectra were acquired for 1000 min. Sample activities were corrected to collection date. Spectra for selected samples were stored permanently electronically for future reference.

Mean thorium and uranium concentrations were estimated from direct measurement of the activity of selected daughter radionuclides and based upon the assumption that all daughter radionuclides were in secular equilibrium with their parents. Direct measurement of the activity of ^{208}Tl (583 keV peak) and ^{214}Bi (609 keV peak) was used to estimate total thorium and uranium concentrations (as μg/g sample). Element concentrations were then converted to activities (pCi/kg) using the following specific activities: One ppm U is approximately equal to 720 pCi of uranium nuclides/kg of sample and one ppm Th is approximately equal to 110 pCi of ^{232}Th/kg of sample.

Radionuclide concentrations and pertinent sample-collection information and analysis parameters were entered into a SAS (Statistical Analysis System, Cary, NC) computer database according to established procedures (Domotor 1986, Frithsen et al. 1996). SAS software was used to analyze and interpret radiological results, model radionuclide concentrations in selected biota and sediments, and generate reports.

2.2.3 Quality Assurance

Spiked "cross-check" samples were received periodically from the Radiochemical and Drinking Water Quality Assurance Program (RADQA), Analytical Sciences Branch, United States Environmental Protection Agency (USEPA) to evaluate the performance of laboratories participating in its intercomparison study program. The results of laboratory analyses were used internally to track instrument performance; if laboratory results fell outside of USEPA uncertainties, the cause of the anomaly was investigated and data from environmental sample analyses were examined for the presence of bias. Laboratory results and USEPA values for the intercomparison study samples are given in Appendix B.

2.3 DETERMINATION OF SEDIMENT CHARACTERISTICS

The size of sediment particles was measured to provide a basis for comparing radionuclide concentrations detected in sediments of different composition (e.g., sand versus clay). Sediment particle size analysis takes into account composition changes which may affect measured radionuclide concentrations at a collection site. Sediments were classified as silt-clay if the mean grain size was less than 63 μm. Sediments were classified as sand if the mean grain size was greater than 63μm (Wentworth scale as published in Buchanan and Kain 1971). Mean grain size was determined by wet- or dry-sieving a 50 g (dry weight) aliquot through 250 μm, 125 μm, and 63 μm mesh. Each fraction was dried and weighed. That portion passing through the 63 μm screen was determined by subtraction from the original 50 g. Sample particle size index values were arrived at by multiplying the fraction percentage of the total weight by four for that retained on the 250 μm mesh, by five for the 125 μm mesh, by six for the 63 μm mesh and by seven for the fraction passing through the 63 μm screen. The sum of these products is the relative particle size index for the sediment sample and ranges from the most coarse, 400 value, where all material is retained on the 250 μm screen, to the most fine, 700 value, where all material passes through the 63 μm screen.

2.4 DATA ANALYSIS

Analytical results were tabulated using computerized gamma spectrum analysis software. When a photopeak was encountered by the software, the corresponding radionuclide was identified and quantified, based on such factors as instrument conditions, volume of sample, and radioactive decay. The activity of a radionuclide of interest is reported as a value with a 2σ uncertainty.

For radionuclides of interest which were found not to be present, the lower limit of detection (LLD) was calculated. For data included in this report, the LLD is defined by the equation given in Table 2-2. Common LLD quantities produced by sample analyses are given in Table 2-3. For the purpose of summarizing data, LLD quantities are disregarded when yearly and overall averages of activity values are calculated.

Table 2-2. Determination of the lower limit of detection.

$$LLD = \frac{2m\sqrt{B}}{T*V*E*2.22*e^{-\lambda\Delta t}}$$

where

B	=	The background counts in the region of interest
m	=	2.327 (based on a Poisson distribution at a confidence level of 99%)
T	=	The sample counting time in minutes
V	=	The mass or volume of sample, in kilograms
E	=	Net system efficiency of counter at the energy region of interest
2.22	=	Disintegrations per minute (dpm) per picocurie (pCi)
λ	=	The radioactive decay constant for the particular radionuclide
Δt	=	The elapsed time between sample collection and counting

Table 2-3. Approximate lower limits (99%) of detection for selected counting geometries (pCi/kg) using a 2-liter Marinelli beaker except as indicated

Radionuclide	Energy (keV)*	Biota (1l) (1 kg wet)	Biota (2 kg wet)	Sand (3 kg dry)	Clay (1.5 kg dry)
^{7}Be	477	80	34	50	110
^{58}Co	811	9	4	6	11
^{60}Co	1173	9	4	5	15
^{95}Zr	757	16	6	12	22
^{95}Nb	766	8	4	8	13
^{103}Ru	498	10	4	10	13
^{106}Ru	622	80	32	50	100
^{110m}Ag	884	9	5	6	14
^{125}Sb	428	28	10	12	32
^{134}Cs	605	9	4	6	12
^{137}Cs	662	11	5	6	12
^{144}Ce	134	60	21	40	77

* keV = thousand electron-volts.

2.5 DETERMINATION OF POWER PLANT CESIUM-137

Cesium-137 is a constituent of both historic weapons test fallout and aqueous effluent from nuclear power plants. The activity of power plant ^{137}Cs is determined by observing ^{134}Cs activity in the environmental sample. Cesium-134 is chemically identical to ^{137}Cs and both are released in a generally consistent ratio over time. Following a decay correction of observed ^{134}Cs in the environmental sample to the time of release, the ^{134}Cs activity is multiplied by the release ratio of ^{137}Cs to ^{134}Cs in aqueous effluent to estimate the quantity of power plant ^{137}Cs in a sample. If ^{134}Cs is not present in the sample, then the entire activity of ^{137}Cs is assumed to be the result of weapons test fallout. The detection limits of power plant ^{137}Cs are higher than fallout-related ^{137}Cs since its activity is dependent on the detection of ^{134}Cs, which has a higher detection limit due to its short half-life in relation to ^{137}Cs. Because of the elevated probability of false-negatives, power plant ^{137}Cs is likely to be under-estimated.

2.6 DATA PRESENTATION

The appendix contains data for radionuclides detected in the environmental samples collected in the vicinity of PBAPS during the 1991 through 1994 monitoring period. The radionuclides reported in these tables include the naturally occurring radionuclides ^{7}Be and ^{40}K, and the power plant produced radionuclides ^{58}Co, ^{60}Co, ^{134}Cs, ^{95}Nb, ^{65}Zn, and ^{95}Zr. Separate tables are provided for sediments, fish (various species), and submerged aquatic vegetation (*Myriophyllum spicatum*). Within each table, specific sample stations are arranged approximately north to south and data are presented by quarter along with annual and overall means for the entire four-year monitoring period.

Data are decay corrected to the date of sample collection. Counting error is reported as ± 2-sigma error. Concentrations for radionuclides of interest that were not detected in specific samples were recorded as less than (LT) the lower limit of detection for that sample as determined by spectrum analysis programs.

3.0 RESULTS AND DISCUSSION

Plant discharge and monitoring data collected during 1991 through 1994 were used to complete assessments to identify and quantify sources of radionuclides, determine the concentration of radionuclides in environmental samples, and estimate potential radiological risks to ecological resources and human health. The results of these assessments are presented in separate sections below.

The origins of more commonly observed radionuclides in environmental samples were identified to assess the impact of PBAPS-related radionuclide releases relative to natural or fallout-related radionuclides. The quantities of individual radionuclides released from PBAPS during 1991 through 1994 are provided to compare to quantities observed in environmental samples collected during the same period. Curie and millicurie levels of **environmentally significant** radionuclides discharged by PBAPS into the aqueous pathway generally translate into picocurie quantities of PBAPS-related radionuclides in environmental samples.

3.1 SOURCES OF RADIONUCLIDES

Nature, atmospheric tests of nuclear weapons, and discharges from PBAPS are the three primary sources of radioactive material in the Susquehanna River and upper Chesapeake Bay. Radionuclides attributable to each of these sources were detected in samples of biota and sediment collected from 1991 through 1994 (Table 3-1).

3.1.1 Radionuclides from PBAPS

The USNRC regulates normal operational releases of radionuclides from nuclear power plants. Quantities of releases from PBAPS were obtained from PECO's semi-annual reports to the USNRC (PECO 1992-1995). Table 3-2 shows that PBAPS released between 7,400 curies (Ci) and 23,600 Ci annually into the Susquehanna River in the form of radioactive gaseous and liquid effluents. Differences between years were attributable to routine changes in plant operations.

Atmospheric releases of noble gases comprised 99% of the radionuclides released from PBAPS between 1991 and 1994. Noble gases are chemically inert, are not readily incorporated into biological tissues, and are not bioconcentrated. They are dispersed in the environment and generally have short half-lives, decaying rapidly to stable forms. Predominantly aqueous releases of tritium comprised most of the remaining 1% of the radioactive material emitted during the period. Dispersion and dilution within the environment rapidly reduce tritium concentrations to background levels. The remaining radionuclides, which constituted less than 1% of the plant's total radioactive releases, included radioiodines and other radionuclides that are considered environmentally significant. Environmentally significant radionuclides are those that have a strong tendency to adsorb onto particles, can accumulate in biological tissues, and potentially be concentrated through trophic transfer. Figure 3-1 shows the relative contributions of noble gases, tritium, and environmentally significant radionuclides in releases from PBAPS between 1991 and 1994.

Table 3-1. Sources for radionuclides potentially present in environmental samples

Radionuclide	Natural	Weapons	Power Plant
^{110m}Ag			x
^{7}Be	x		
^{14}C	x	x	x
^{141}Ce		x	x
^{144}Ce		x	x
^{58}Co			x
^{60}Co		x	x
^{51}Cr			x
^{134}Cs			x
^{136}Cs		x	x
^{137}Cs		x	x
^{64}Cu			x
^{55}Fe			x
^{3}H	x	x	x
^{131}I			x
^{40}K	x		
^{140}La			x
^{54}Mn			x
^{24}Na			x
^{95}Nb		x	x
^{32}P			x
^{103}Ru		x	x
^{106}Ru		x	x
^{125}Sb		x	x
^{89}Sr		x	x
^{90}Sr		x	x
^{232}Th series	x		
^{238}U series and ^{235}U series	x		
^{133}Xe		x	x
^{65}Zn			x
^{95}Zr		x	x

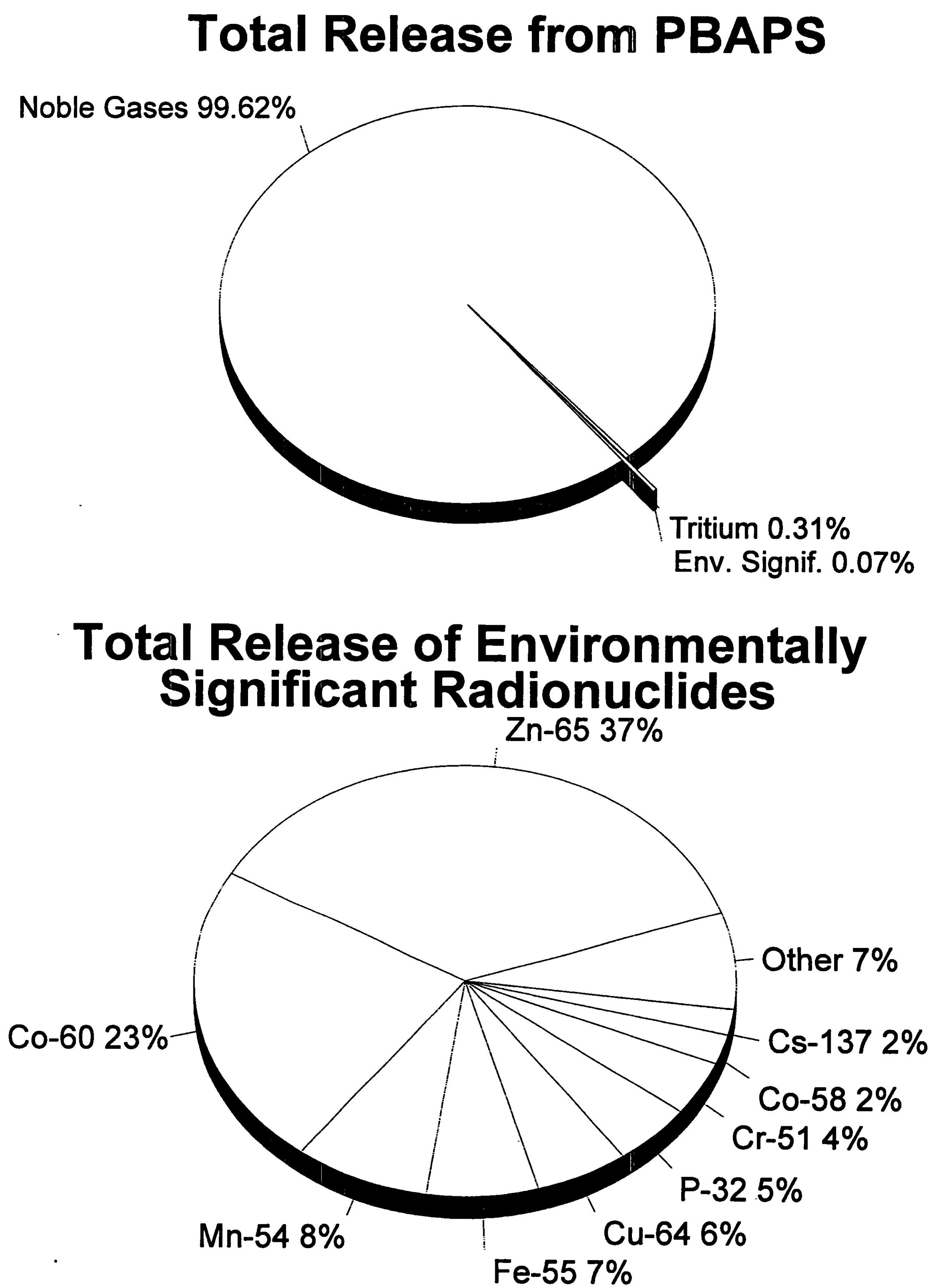

Figure 3-1. Relative contributions of noble gases, tritium, and environmentally significant radionuclides released from PBAPS, 1991-1994. Noble gases include atmospheric and dissolved gases.

Table 3-2. Annual releases (curies) from all pathways of noble gases, tritium, iodines and particulates from PBAPS, 1991-1994. Source: PECO 1992-1995.

	Total	Noble Gases[a]	Tritium[b]	Iodines and Particulates[b]
1991	23,598.97	23,544.12	54.47	0.38
1992	8,032.21	7,974.49	57.39	0.33
1993	8,853.03	8,822.25	30.01	0.77
1994	7,363.77	7,356.74	6.53	0.50
TOTAL	47,847.98	47,697.60	148.40	1.98

[a] Noble gases are released to the environment via atmospheric pathways.
[b] Tritium, iodines, and particulate radionuclides are released to the environment predominantly via aqueous pathways.

From 1991 through 1994, PBAPS released 0.2 Ci of radioiodines and other environmentally significant radionuclides to the Susquehanna River in the form of aqueous discharge and another 1.79 Ci as atmospheric discharge. Table 3-3 lists the principal environmentally significant radionuclides released via the aqueous pathway, the quantities of each released from 1991 through 1994, and their half-lives. Radionuclides which have longer half-lives, such as ^{60}Co (half-life = 5.3 years), have the potential to persist longer than shorter lived radioisotopes in the environment. Table 3-3 also identifies which of these radionuclides were found in samples of sediment and biota. PBAPS released ^{65}Zn, ^{60}Co, and ^{54}Mn in the greatest quantities during the monitoring period.

Releases of radionuclides from PBAPS are variable. Figures 3-2 through 3-5 depict historical trends in the quantities of PBAPS's aqueous release of environmentally significant radionuclides. Total releases of ^{134}Cs, ^{137}Cs, ^{65}Zn, and ^{60}Co during 1991 through 1994 remained consistently much lower than levels reported since the beginning of PPRP's monitoring effort in 1979. Total releases of the other environmentally significant radionuclides between 1991 and 1994 remained as low as those reported in previous years. The relatively short half-lives and small quantities of these radionuclides produce concentrations in the environment that have historically been detected generally in the vicinity of PBAPS's discharge, and only after periods of sufficiently high release of the nuclide (McLean and Domotor 1988, Domotor and McLean 1989).

Table 3-3. Quantities of environmentally significant radionuclides released from PBAPS via the aqueous pathway during the period 1991-1994. Source: PECO 1992-1995.

Radionuclide	Half-life	Quantity (Ci)	Sediment	Biota
^{65}Zn	275.0 days	0.07	yes	yes
^{60}Co	5.3 years	0.04	yes	yes
^{54}Mn	312.7 days	0.02	no	no
^{51}Cr	27.7 days	0.01	yes	no
^{32}P	14.3 days	0.01	no	no
^{55}Fe	2.7 years	0.01	no	no
^{64}Cu	12.7 hours	0.01	no	no
^{137}Cs	30.2 years	0.004	yes	yes
^{58}Co	70.8 days	0.004	no	no
^{110m}Ag	249.9 days	0.004	no	no
^{90}Sr	28.6 years	0.003	no	no
^{24}Na	15.0 hours	0.003	no	no
^{134}Cs	2.1 years	0.002	yes	no
^{131}I	8.0 days	0.002	no	yes
^{92}Sr	2.7 hours	0.001	no	no
^{89}Sr	50.6 days	0.001	no	no
^{125}Sb	2.8 years	**	no	no
^{140}La	40.2 hours	**	no	no
^{95}Nb	35.0 days	**	yes	no

Note:
yes = detected in samples
no = not detected in samples
** = <0.001 Ci

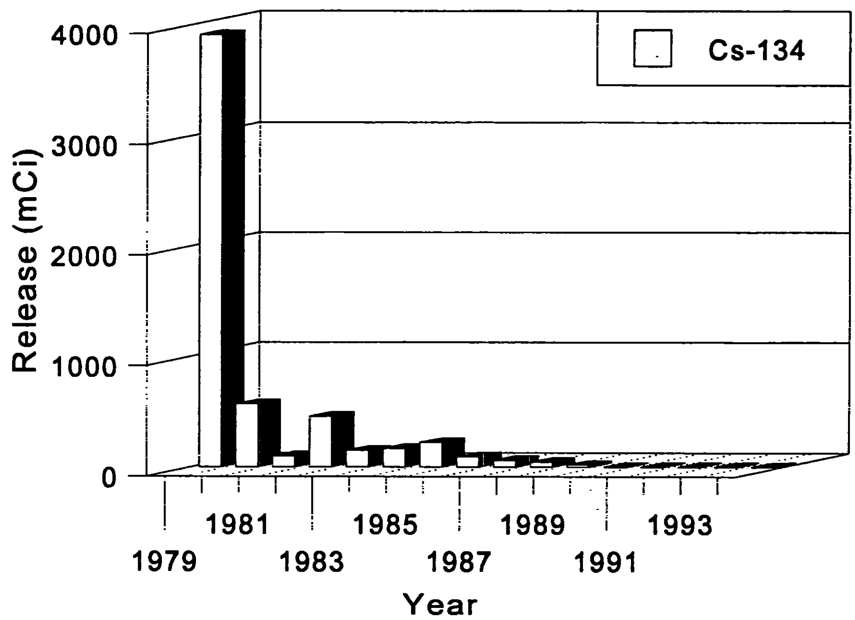

Figure 3-2. Annual aqueous release of ^{134}Cs from PBAPS, 1979-1994. Source: PECO 1980-1995. PBAPS did not operate between April 1987 and April 1989.

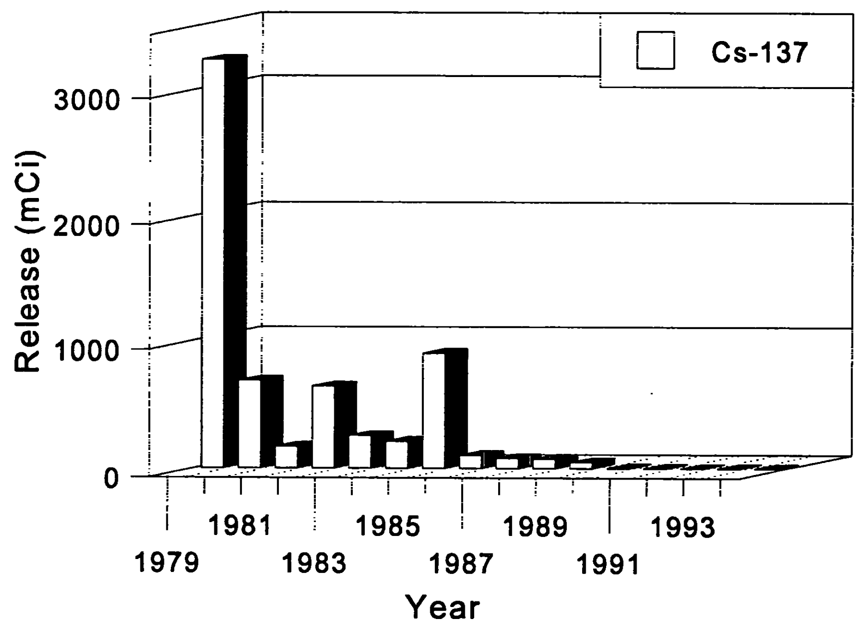

Figure 3-3. Annual aqueous releases of ^{137}Cs from PBAPS, 1979-1994. Source: PECO 1980-1995. PBAPS did not operate between April 1987 and April 1989.

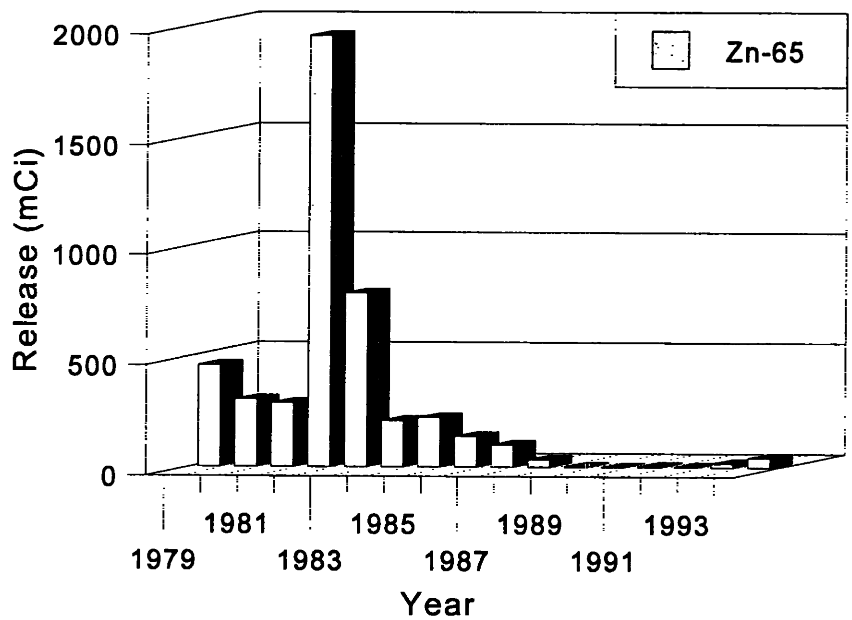

Figure 3-4. Annual aqueous releases of ^{65}Zn from PBAPS, 1979-1994. Source: PECO 1980-1995. PBAPS did not operate between April 1987 and April 1989.

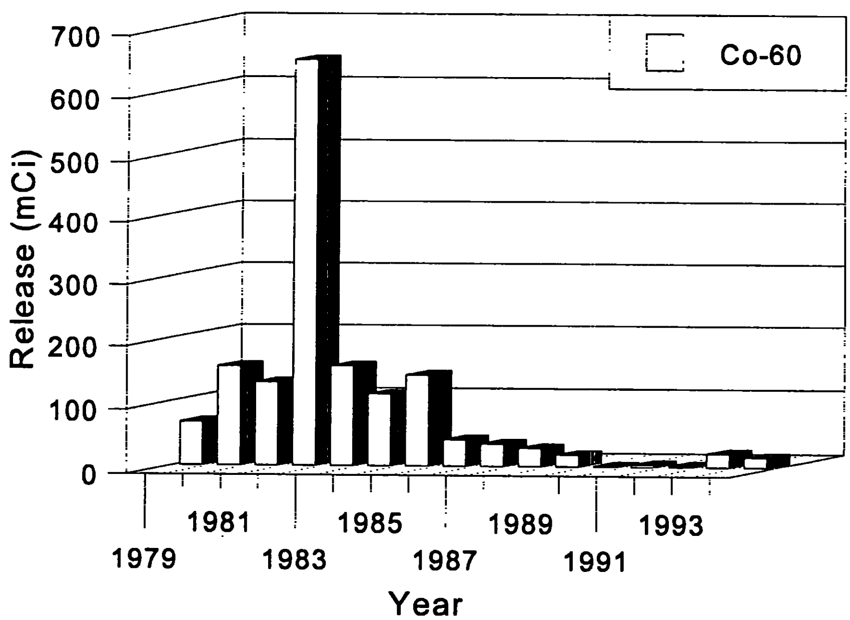

Figure 3-5. Annual aqueous releases of ^{60}Co from PBAPS, 1979-1994. Source: PECO 1980-1995. PBAPS did not operate between April 1987 and April 1989.

3.1.2 Natural Radionuclides

Natural sources of radiation are present everywhere. Principal naturally occurring radionuclides that result in measurable radiological doses to human populations include ^{40}K, ^{232}Th, and ^{238}U. Thorium and uranium each initiate a decay series of radioactive progeny (those which emit gamma rays) that were detected in nearly all samples of biota and sediment from PBAPS. These radionuclides generally are found in very small concentrations; however, ^{40}K (half-life = 1.26×10^9 yr) is abundant and is present nearly everywhere in the environment.

Cosmic rays produce several radionuclides in the atmosphere (Whicker and Schultz 1982). Of these, ^{7}Be was detected frequently in sediments and occasionally in biota from PBAPS; however, the natural production of ^{7}Be (half-life = 53 d) in the atmosphere contributes only a small portion of the total radiation dose from natural background.

3.1.3 Radionuclides from Weapons Tests

Atmospheric tests of nuclear weapons, conducted until 1980, have introduced a variety of man-made radionuclides into the environment. Cesium-137, a fallout radionuclide with a half-life of 30 years, was the only radionuclide attributable to weapons testing detected during the monitoring period.

3.1.4 Comparisons to Calvert Cliffs Nuclear Power Plant

The two principal sources of power plant produced radionuclides in environmental media collected in Maryland are PBAPS and the Calvert Cliffs Nuclear Power Plant (CCNPP). Both plants released noble gases, tritium, and environmentally significant radionuclides (iodines and particulates). All releases of radionuclides from PBAPS and CCNPP were the result of normal plant operation and maintenance procedures and were within regulatory limits established by the USNRC. Compared with PBAPS, CCNPP released 73% less radioactivity during the 1991 through 1994 monitoring period (Figure 3-6). Noble gases comprised 68% of the radionuclides released from CCNPP whereas 99% of all releases from PBAPS were noble gases. Environmentally significant radionuclides released from CCNPP were three times the quantity released from PBAPS. Additionally the release of tritium from CCNPP was twenty-eight times the tritium released from PBAPS. These differences are a reflection of plant design; PBAPS has a boiling water reactor whereas CCNPP has a pressurized water reactor.

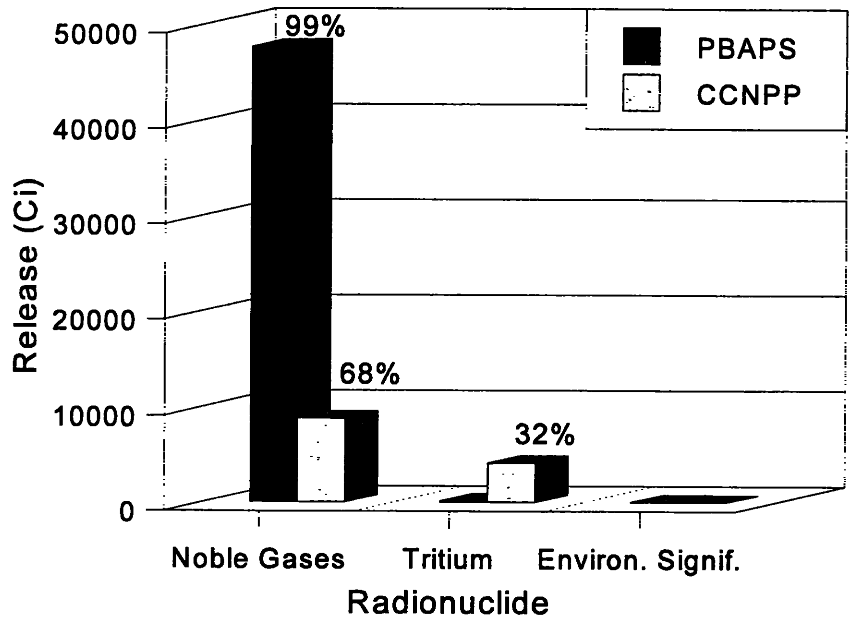

Figure 3-6. Annual releases of noble gases, tritium, and environmentally significant radionuclides from PBAPS and CCNPP, 1991-1994. Noble gases include atmospheric and dissolved gases. Environmentally significant radionuclides include iodines and particulates.

3.2 RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

3.2.1 Sediments

Sediments serve as sinks for both stable and radioactive metals. Suspended particulate material can scavenge metals through flocculation and adsorption, or the surface layer of bottom sediments may sorb metals directly from the water column (Santschi et al. 1983). Because of these processes, sediments accumulate radionuclides over time. Sediments collected from the Susquehanna River-Chesapeake Bay system have been used to identify the fate and behavior of released radionuclides through measurement of the spatial and temporal patterns of radionuclide concentrations caused by physical transport of radionuclides and intra-annual variability in the release of radionuclides from the plant since 1979. PPRP's monitoring results for sediment collected between 1991 and 1994 are summarized below. Where relevant, radionuclide concentrations detected in sediments are compared with levels observed during previous reporting periods. Appendix C presents concentrations of selected radionuclides detected in all of the sediment samples collected between 1991 and 1994.

A variety of factors influence the concentrations of radionuclides in sediments. These include: rate of input, geographic location in relation to the power plant (distance, if applicable), half-life of the radionuclide, natural estuarine processes such as sedimentation, circulation, and bioturbation, depth of the sediment layer from the water surface, and sediment grain size. Sediment grain size was the only factor specifically analyzed for this report. Sediments collected at inshore stations and Susquehanna Flats were composed predominantly of sand; sediments from Conowingo Pond and upper Chesapeake Bay, which were collected from depths greater than 8 m, were mostly clay (Figure 3-7).

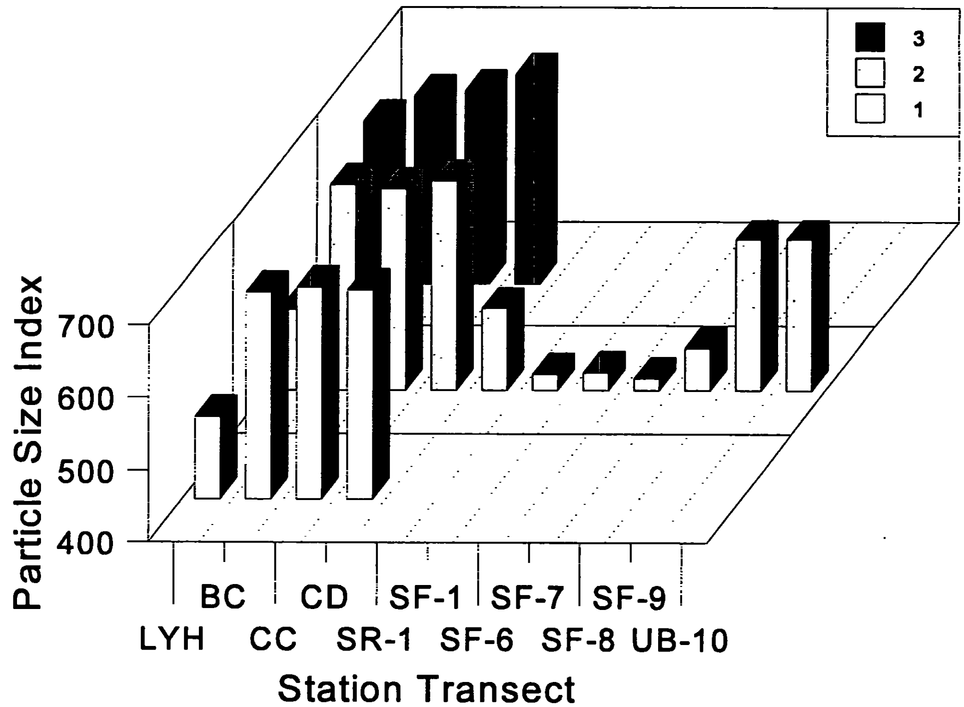

Figure 3-7. Mean particle size values for sediments collected from Conowingo Pond and upper Chesapeake Bay, 1991-1994

Radionuclides from natural sources (^{7}Be, ^{40}K, Th and U decay series), weapons-test fallout (^{137}Cs), and PBAPS discharges (^{60}Co and ^{65}Zn) were generally detected at higher concentrations in clay sediments than in sand sediments during 1991-1994 (Figures 3-8 through 3-10). Radionuclides have a greater affinity for clay, rather than sand, due to the former's fine crystalline structure, greater surface area, and the higher cation exchange capacity of clay particles (Eisenbud 1987). Sandy sediments are coarser and less able to sorb radionuclides (Olsen et al. 1989).

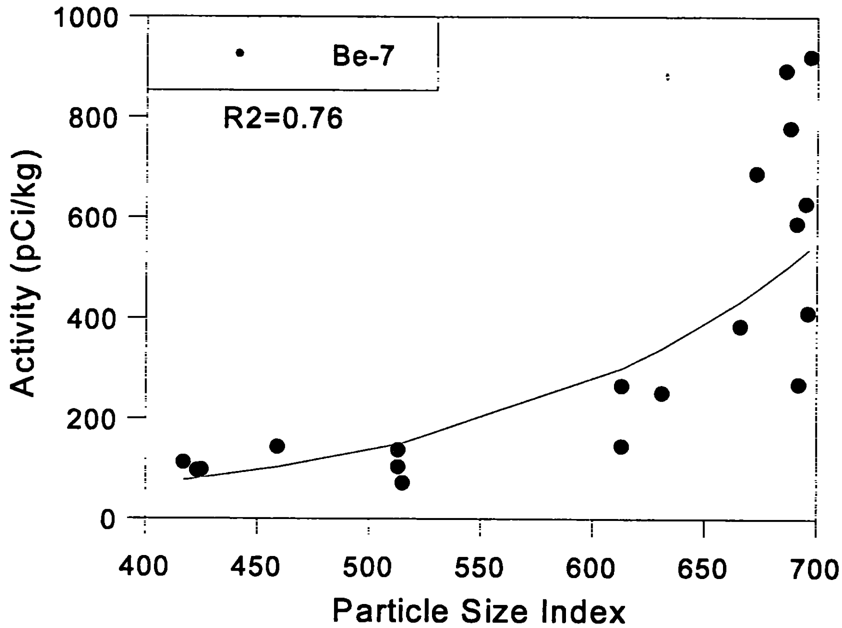

Figure 3-8. Relationship between ^{7}Be activity and particle size index.

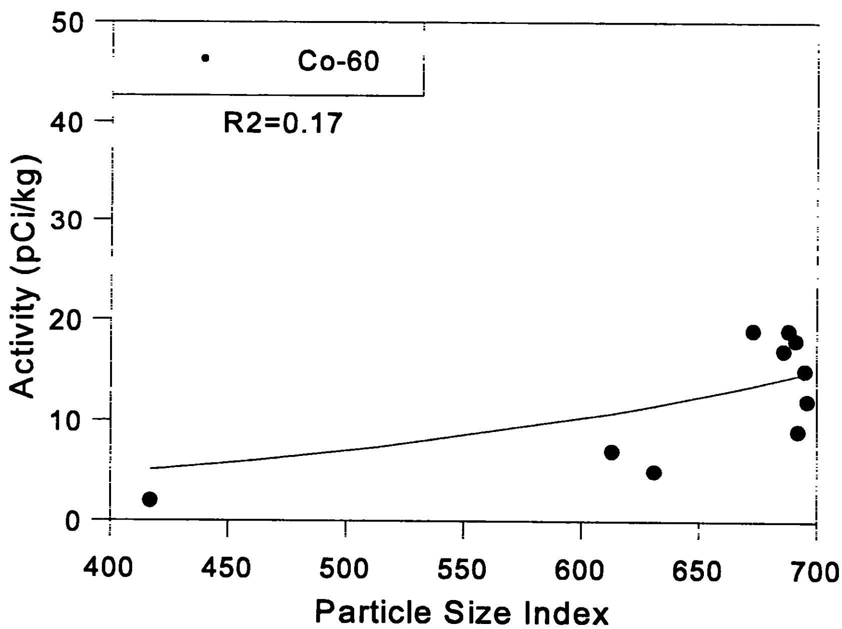

Figure 3-9. Relationship between ^{60}Co activity and particle size index.

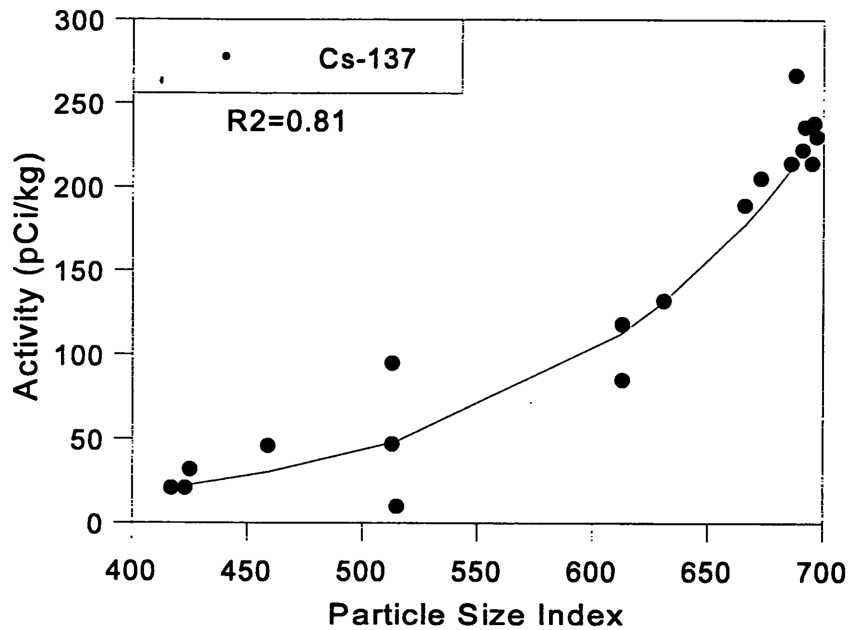

Figure 3-10. Relationship between ^{137}Cs activity and particle size index.

3.2.1.1 Radionuclides from PBAPS

Figure 3-11 shows the environmentally significant radionuclides found most frequently in sediment samples from the Susquehanna River-Chesapeake Bay system. Cobalt-60 was found in 18% of sediment samples and was the primary PBAPS-related radionuclide found. Other radionuclides, such as ^{65}Zn, ^{134}Cs, ^{137}Cs, ^{95}Nb, and ^{51}Cr (in order of detection frequency) were found less often, in just 7% of sediment samples. The detection frequency of the major radionuclides (^{60}Co, ^{65}Zn and ^{134}Cs) was higher in the 1987-1990 reporting period.

Cobalt-60, ^{134}Cs, ^{137}Cs, ^{65}Zn, ^{95}Nb, and ^{51}Cr generally react with water-borne particles. The distributions of these radionuclides in the sediments of the Susquehanna River and upper Chesapeake Bay reflects this behavior, the highest concentrations were measured in sediments from Conowingo Pond immediately downstream of the plant's discharge. Concentrations generally decreased with distance from PBAPS and were lowest in the sandy sediments of the upper Chesapeake Bay.

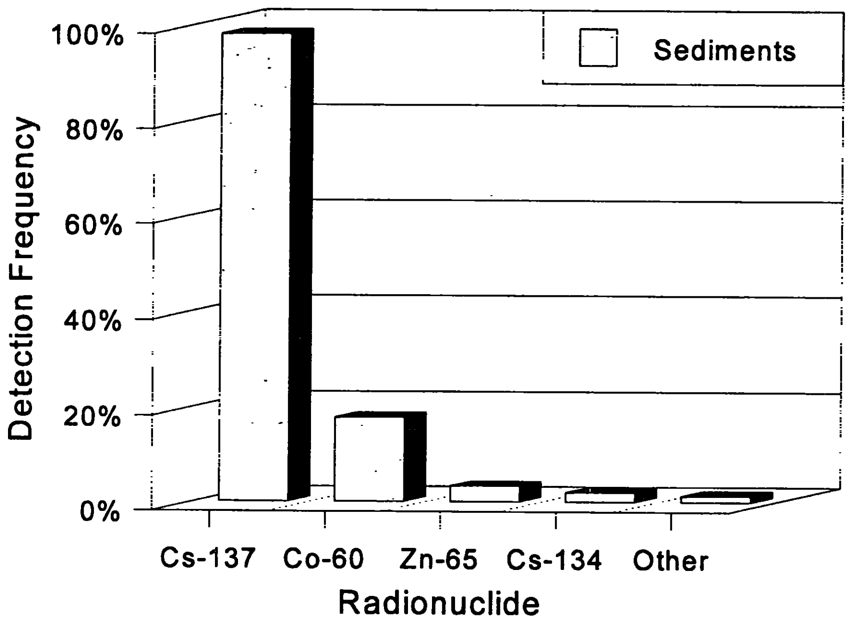

Figure 3-11. Radionuclides detected in sediment samples collected from Susquehanna River-Chesapeake Bay system, 1991-1994. The category "other" includes ^{95}Zr, ^{95}Nb, and ^{144}Ce.

Seasonal variations in flow in the Susquehanna River (Figure 3-12) have been known to influence the distribution of PBAPS-labelled particulates within the lower Susquehanna River and upper Chesapeake Bay. Low river flows (typical during late summer through fall) permit the deposition of PBAPS-labelled particulates on the Susquehanna Flats, whereas high flows (typical during late winter through spring) scour and resuspend particulate material from the sediment bed and transport suspended sediment down-bay. While this effect has been apparent in the past (Domotor and McLean 1989), a significant decline in PBAPS emissions in the last decade has made it less so.

Cesium-137 and ^{134}Cs. Because ^{134}Cs and ^{137}Cs are chemically identical, the presence of ^{134}Cs (which is solely attributable to PBAPS discharges) in sediment samples suggests that some fraction of the ^{137}Cs in sediment samples collected during the monitoring period was PBAPS-related. The yearly release rates of ^{134}Cs and ^{137}Cs from the power plant appear to rise and fall in tandem, lending support to a qualitative correlation between ^{134}Cs detection and power-plant sourced ^{137}Cs deposition (Figure 3-13).

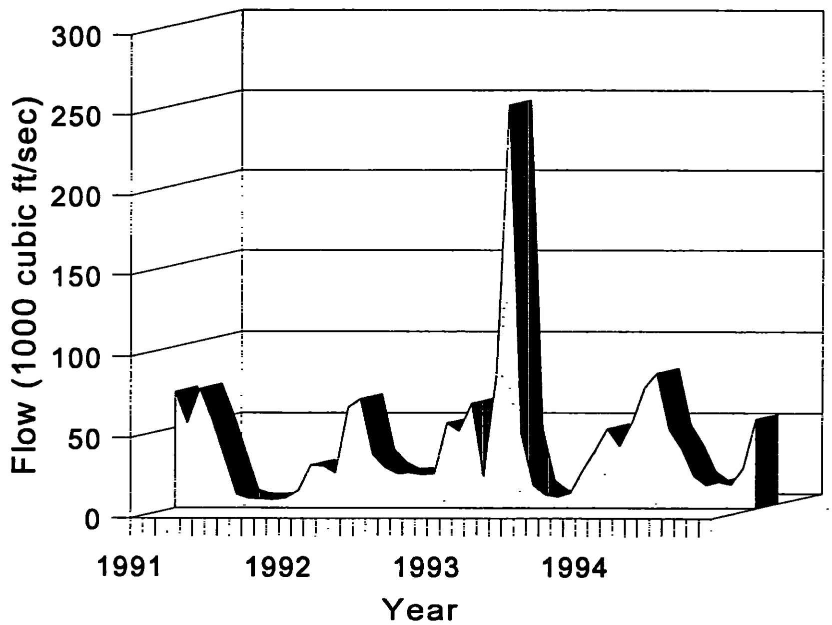

Figure 3-12. Monthly flow of Susquehanna River at Conowingo Dam, 1991-1994. Source: James et al. 1991-1995.

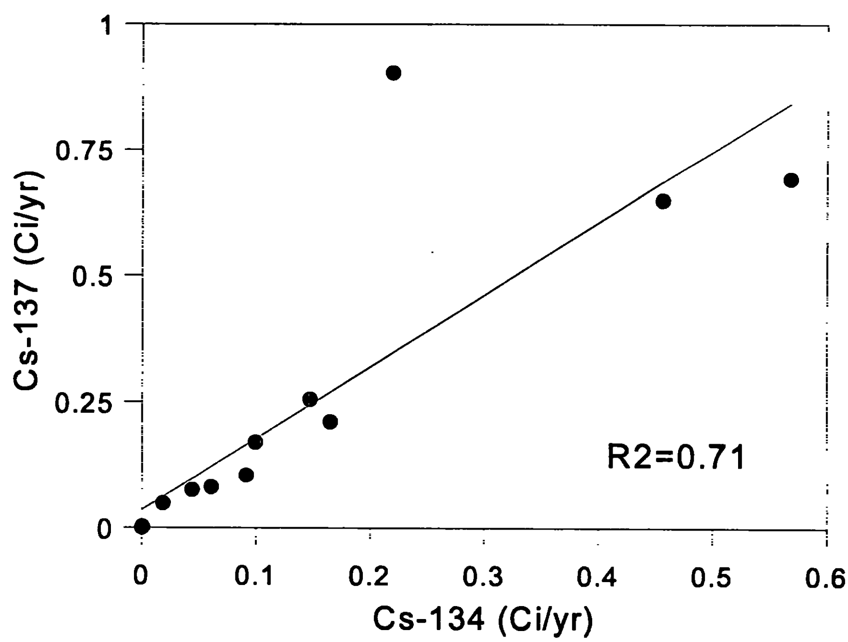

Figure 3-13. Relationship of ^{134}Cs release to ^{137}Cs release, 1979-1994.

Cesium-134 was detected twice at Little Yellow House-1 station (adjacent to the power plant outfall). This suggests that radiocesium deposition at this station continues to occur or that radioactivity levels continue to be elevated from historical buildup. Additionally, the concentration of ^{137}Cs appears inordinately high compared to activities observed in other sandy sediment. Another random ^{134}Cs detect occurred at the Conowingo Dam; ^{134}Cs detection occurred nowhere else.

Cobalt-60 was detected at lower concentrations and less frequently during the current monitoring period compared to previous monitoring periods (Stanek and McLean 1995a, Domotor and McLean 1989, McLean and Domotor 1988). Cobalt-60 resident in sediment continues to decay (half-life = 5.3 years) and be diluted by sedimentation. In previous reports, it appeared that ^{60}Co was deposited in a plume which hugged the western shore of the pond, as shown by elevated levels at westernmost stations, with sedimentary distribution evening out closer to the dam. In the current monitoring period, residual elevated ^{60}Co levels appear only at the westernmost LYH and BC transects. Cobalt-60 activity below the dam was also reduced and detected less frequently.

Zinc-65 was detected in five sediment samples. This radionuclide was released in the greatest quantity, but does not persist long in sediments due to its short half-life. This nuclide did not appear localized at LYH-1 (near the outfall) as reported in previous monitoring periods. No ^{65}Zn deposition was detected below the dam.

3.2.1.2 Natural Radionuclides

The major component of sediment radioactivity were the naturally occurring radionuclides and included various radionuclides of the thorium and uranium decay chains, ^{40}K, and ^{7}Be. These radionuclides were responsible for over 95% of the radioactivity found in all environmental samples.

Thorium and Uranium. Nuclear decay of natural thorium (^{232}Th) and natural uranium (^{238}U) produces gamma-emitting daughter elements (e.g., thorium: ^{228}Ac, ^{208}Tl, ^{212}Pb; uranium: ^{226}Ra, ^{214}Bi, ^{214}Pb) that accounted for most radionuclides in sediments. Mean thorium concentrations generally ranged from 3000 to 30000 pCi/kg with highest concentrations occurring in fine-grained sediments. Uranium concentrations ranged from 50 to 500 pCi/kg.

Potassium-40 was detected consistently in all sediments during the monitoring period. Potassium-40 concentrations are proportional to stable potassium content. The range of ^{40}K concentrations indicated that the potassium content of sediment ranged from 0.2% to 3% by dry weight. Potassium-40 concentrations were highest in predominantly fine-grained sediments.

Beryllium-7 is a natural radionuclide produced by the interaction of cosmic rays with atmospheric oxygen and nitrogen. It is deposited on water and soil surfaces through precipitation scavenging and may enter the water through runoff from land. It adsorbs rapidly to particles suspended in the water column and appears in sediments as a result of particulate deposition. Beryllium-7 was detected sporadically and in highly variable concentrations in sediments during the monitoring period. Concentrations of ^{7}Be were generally higher in clay sediments, particularly those collected from stations in Conowingo Pond closer to the Conowingo Dam (Conowingo Creek and Conowingo Dam transects). Concentrations at sampling stations below Conowingo Dam tended to be lower due to the dominance of sandy sediment.

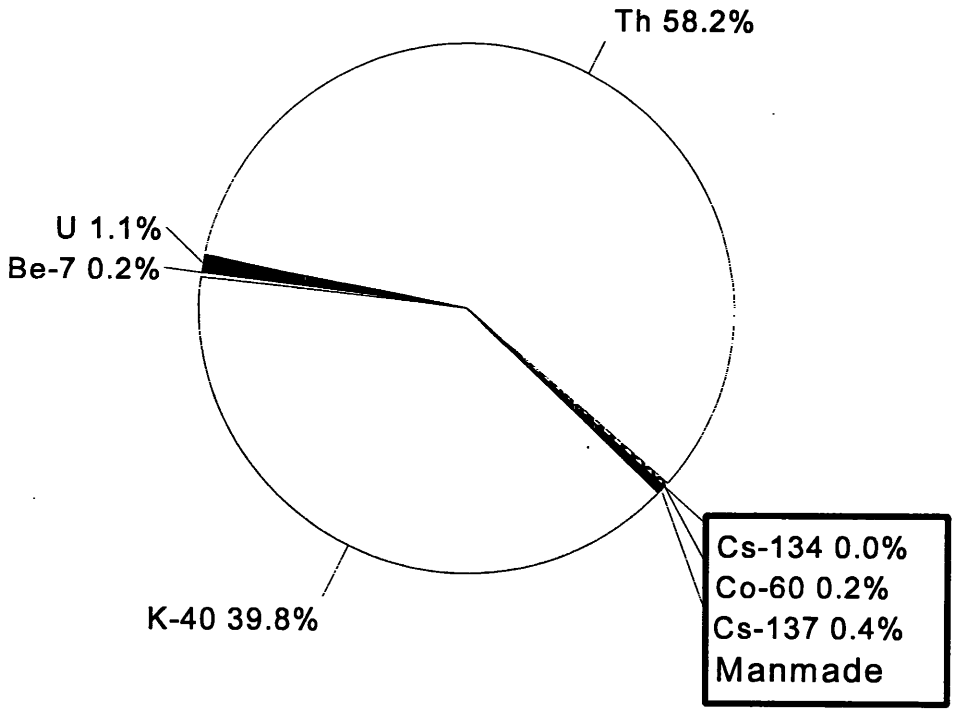

Figure 3-14. Proportion of natural vs. man-made (plant plus weapons) radionuclides in sediment samples. Specific data from the Little Yellow House transect Station #1.

3.2.1.3 Radionuclides from Weapons Tests

The variety, concentrations, and frequency of detection of radionuclides from weapons tests in sediments collected near PBAPS has decreased continually since 1981. Other than ^{137}Cs, no fallout radionuclides were detected in sediments during the monitoring period.

Cesium-137 has been distributed worldwide and continued to be universally prevalent (98%) in sediment samples from the Susquehanna River-Chesapeake Bay system. Nearly all of the ^{137}Cs present in sediments originated from atomic weapons testing. Compared to the previous monitoring period (Stanek and McLean 1995a), the radionuclide is present at slightly reduced concentrations, mainly due to decay of radionuclide inventory already present and dilution caused by sedimentation. Concentrations of ^{137}Cs were an order of magnitude less in sandy sediments of the Susquehanna Flats below Conowingo Dam than above.

3.2.2 Biota

Detectable concentrations of plant-related ^{65}Zn and ^{60}Co were found in finfish and SAV samples (Figure 3-15). The plant-related radionuclide detected most frequently during the monitoring period was ^{65}Zn (19% of biota samples collected in 1994).

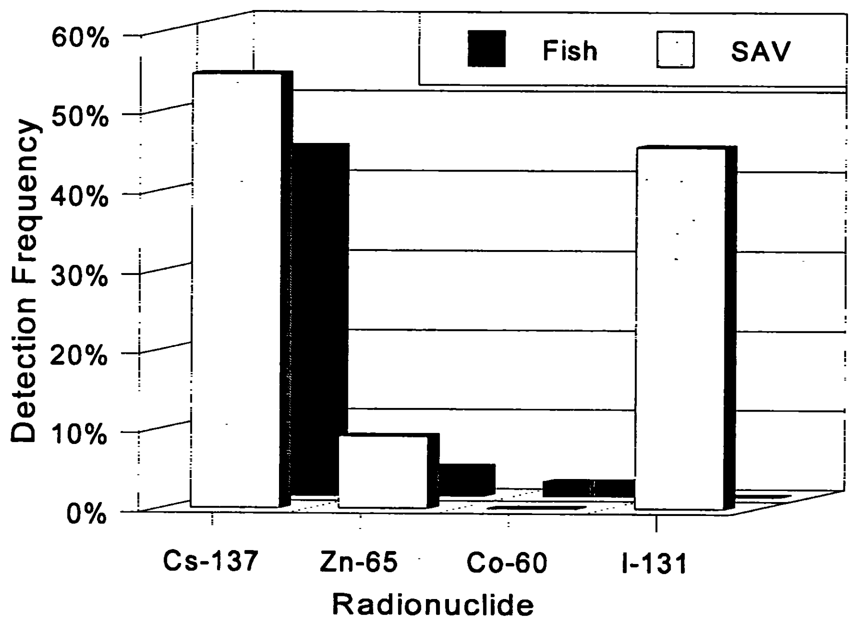

Figure 3-15. Radionuclides detected in biota samples collected from the Susquehanna River-Chesapeake Bay system, 1991-1994

PPRP's monitoring results for biota collected between 1991 and 1994 are presented in Appendix C and summarized below. Where relevant, radionuclide concentrations detected in biota are compared with levels observed during previous reporting periods.

3.2.2.1 Finfish

Concentrations of PBAPS-related radionuclides in forage fish and edible finfish collected during the monitoring period were very small or not detectable. From 1991 through 1994, PBAPS-related radionuclides were detected in finfish collected from the Conowingo Pond only. Radionuclide concentrations were generally smaller than during previous reporting periods. The smaller concentrations probably reflect the continued smaller quantities of environmentally significant radionuclides released by PBAPS.

Small concentrations of ^{137}Cs, ^{60}Co, and ^{65}Zn were detected sporadically in a variety of forage and edible finfish collected from the Conowingo Pond from 1991 through 1994. Cobalt-60 and ^{65}Zn were solely attributable to PBAPS, whereas ^{137}Cs was attributable to weapons-test fallout. Table 3-4 presents the maximum concentrations of PBAPS-related radionuclides detected in selected finfish from the Conowingo Pond and Conowingo Dam tailrace. Maximum ^{137}Cs levels in finfish flesh (smallmouth bass & carp) and whole forage finfish (gizzard shad) occurred in Fall 1991.

Table 3-4. Maximum concentrations of PBAPS-related radionuclides in selected finfish collected from the Conowingo Pond and the Conowingo Dam tailrace (pCi/kg wet ± 1.96σ counting statistics), 1991-1994.

Location	Nuclide	Gizzard Shad	Carp		Catfish		Smallmouth Bass	
		Whole	Flesh	Gut	Flesh	Gut	Flesh	Gut
Pond	^{134}Cs	< 7	< 5	< 99	< 4	< 71	< 9	< 112
	^{137}Cs	25 ± 9	6 ± 3	96 ± 47	13 ± 5	< 79	10 ± 10	< 113
	^{65}Zn	< 18	8 ± 7	< 244	< 23	< 202	< 38	< 265
Dam	^{134}Cs	< 4	< 3	< 27	< 6	< 97	< 3	< 30
	^{137}Cs	< 5	6 ± 4	< 29	7 ± 7	< 94	10 ± 5	< 33
	^{65}Zn	< 12	< 9	< 79	< 16	< 245	< 10	< 74

PBAPS-related ^{60}Co was detected infrequently in gizzard shad (whole), while ^{65}Zn was detected sporadically in flesh of carp, gizzard shad, red sucker, and sunfish. All of the ^{65}Zn detects occurred in 1994. In contrast to the 1987 to 1990 monitoring period, no finfish contained ^{134}Cs. No PBAPS-related nuclides were detected in finfish sampled from below the Conowingo Dam.

3.2.2.2 Submerged Aquatic Vegetation (SAV)

Eurasian milfoil (*Myriophyllum spicatum*) collected from the Susquehanna River-Chesapeake Bay system from 1991 through 1994 contained small concentrations of radionuclides attributable to PBAPS' discharges, weapons-test fallout, and discharges from a medical facility.

PBAPS-related ^{65}Zn was detected in one milfoil sample collected during 1994. No PBAPS-related increments of ^{137}Cs were detected in any milfoil samples.

Cesium-137 was detected sporadically (3 to 10 pCi/kg wet) in milfoil collected from the Susquehanna River and Flats. Concentrations were similar to those detected during previous reporting periods (Stanek and McLean 1995a) and were consistent with levels attributable to weapons-test fallout.

Iodine-131 was detected frequently in milfoil collected from the Susquehanna River and Flats. Iodine-131 concentrations (4 to 29 pCi/kg wet) were similar to those detected during previous years (Stanek and McLean 1995a). Analysis of these samples before and after a tapwater rinse indicated that ^{131}I appears to have been incorporated into SAV tissue rather than deposited on the leaves. This observation has been noted previously (Stanek and McLean 1995a). Although PBAPS releases ^{131}I, the principal source of ^{131}I is probably the result of in-patient nuclear medicine procedures involving its use at several hospitals within the Susquehanna watershed. Two millicuries of ^{131}I were released from PBAPS in the current monitoring period, whereas activities may range from 15 mCi dosages per case for hypothyroidism to several hundred mCi dosages per case for thyroid cancer (NCRPM 1996).

3.3 RADIOLOGICAL EFFECTS ON THE ENVIRONMENT AND HUMAN HEALTH

3.3.1 Effect on the Environment

Although small concentrations of radionuclides attributable to discharges from PBAPS were detected in most of the biota collected between 1991 and 1994, the maximum detected concentrations were orders of magnitude smaller than concentrations of natural radionuclides. Radiation doses to aquatic organisms attributable to PBAPS-related discharges are an insignificant proportion of doses derived from natural radionuclides (Whicker and Schultz 1982). Living organisms normally receive most of their external dose from naturally occurring radionuclides and their internal exposure from naturally occurring radionuclides such as ^{40}K. Adverse effects on sensitive aquatic vertebrates have been detected at dose rates as low as 0.4 mGy/h (40 mrad/h or approximately 1400 rem over 4 years; Eisler 1994).

3.3.2 Effect on Human Health

Potential radiation doses to human consumers of finfish were estimated based upon measured concentrations of radionuclides in edible fish. Doses were expressed as "dose commitment" which in this report refers to the total dose to a tissue or organ during a period of 50 years following ingestion, after allowing for the metabolic processes of excretion and radioactive decay. The dose commitment calculations are based on three variables. The first variable is the maximum, or worst-case, estimated concentration of plant-related radionuclides in finfish collected from the Conowingo Pond or Conowingo Dam. The second variable is an estimate of the maximum quantity of fish consumed by an individual according to age (i.e., child = 6.9 kg/yr; teen = 16 kg/yr; adult = 21 kg/yr; USNRC 1977). The third variable is the dose from the intake of a radionuclide (USNRC 1977).

Table 3-5 presents estimated dose commitments to adults, teenagers, and children. The estimated maximum dose from consumption of finfish was 0.04 mrem/yr to a teenager's liver during 1991 through 1994. The estimated maximum total body dose was 0.02 mrem/yr. These estimates are well below design limits stipulated in 10 CFR Part 50 Appendix I, which restricts total body doses to a maximally exposed individual to 3 mrem/yr for the aqueous pathway (USNRC 1977).

Table 3-5. Estimated maximum dose commitments* to an individual consuming finfish from the Conowingo Pond or Conowingo Dam, 1991-1994. Recommended consumption values and conversion factors derived from USNRC 1977.

Age Group	1991-1994		
	Adult	**Teen**	**Child**
Total Body			
^{65}Zn	0.0035	0.036	0.038
^{134}Cs	0.0000	0.000	0.000
^{137}Cs	0.0195	0.108	0.041
TOTAL	0.0230	0.144	0.079
Bone			
^{65}Zn	0.0024	0.0022	0.0023
^{134}Cs	0.0000	0.0000	0.0000
^{137}Cs	0.0218	0.0233	0.0293
TOTAL	0.0242	0.0255	0.0316
Liver			
^{65}Zn	0.0078	0.0077	0.0060
^{134}Cs	0.0000	0.0000	0.0000
^{137}Cs	0.0298	0.0310	0.0281
TOTAL	0.0375	0.0387	0.0341
Kidney			
^{65}Zn	0.0052	0.0049	0.0038
^{134}Cs	0.0000	0.0000	0.0000
^{137}Cs	0.0101	0.0105	0.0091
TOTAL	0.0153	0.0155	0.0130
Gastrointestinal tract - lower large intestine			
^{65}Zn	0.0049	0.0033	0.0011
^{134}Cs	0.0000	0.0000	0.0000
^{137}Cs	0.0006	0.0004	0.0002
TOTAL	0.0055	0.0037	0.0012

* Dose commitment: $\frac{kg}{yr} \times \frac{mrem}{pCi} \times \frac{pCi}{kg}$

4.0 CONCLUSIONS

During the 1991-1994 monitoring period, PBAPS released radionuclides to the environment as a normal consequence of routine operations and all quantities were less than regulatory limits set by the USNRC. Radionuclides released from the plant were detected in sediments and biota collected from the Susquehanna River and Chesapeake Bay; however, concentrations and the frequency of detection in environmental samples was generally lower than that reported for previous monitoring periods. Plant-produced radionuclides were detected at highest concentrations in samples collected from Conowingo Pond. Few samples collected south of Conowingo Dam showed evidence of plant produced radionuclides.

Radionuclides from PBAPS, nuclear weapons testing, and natural sources contributed to the total radioactivity measured in environmental samples. Generally, radionuclides from natural sources (primarily radionuclides from the uranium and thorium decay series, ^{40}K, and ^{7}Be) contributed most to the total radioactivity of environmental samples.

The measured concentrations of radionuclides in sediments and biota do not represent a risk to the ecological health of the Susquehanna River-upper Chesapeake Bay system. The additional increment of radioactivity and radiation dose attributable to the operation of PBAPS is minimal when compared with natural levels of radioactivity and the associated natural radioactive dose. The concentrations of radionuclides in sediments and biota would increase the radiological dose to man by no more than 0.1%. This is an insignificant increase in radiation dose when compared with the dose to human populations attributable to natural background sources which vary according to geographic region and elevation, habitat type (i.e. construction material used in residences), life-style choices (i.e. smoking, occupation), and routine medical procedures.

5.0 REFERENCES

BGE (Baltimore Gas and Electric Company). 1992-1995. Semi-annual effluent release reports for Calvert Cliffs Nuclear Power Plant, January 1 - December 31, 1991-1994.

Buchanan, J.B. and J.M. Kain. 1971. Measurement of the physical and chemical environment. *In:* Methods for the Study of Marine Benthos, 30-50. N.A. Holme and A.D. McIntyre, eds. Oxford, England: Blackwell Scientific Publications.

Domotor, S.L. 1986. Maryland Power Plant Siting Program radioecology data base management system: Format for coding radioecology data. PPRP-R-6. January, 1986. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

Domotor, S.L. and R.I. McLean. 1989. Environmental radionuclide concentrations in the vicinity of the Peach Bottom Atomic Power Station: 1985-1986. PPER-R-11. July, 1989. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

Eisenbud, M. 1987. Environmental Radioactivity from Natural, Industrial, and Military Sources. Third edition. Orlando, FL: Academic Press, Inc.

Eisler, R. 1994. Radiation Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. U.S. Department of the Interior, National Biological Service, Washington, DC. Biological Report 26.

Frithsen, J.B., M.A. Stanek, J. Chaillou, M. Gaughan, and R.I. McLean. 1996. Documentation for the PPRP Radioecology Data Base: Data Formats and Data Entry Procedures. PPRP-R-22. April 5, 1996. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

GPUN (General Public Utility Nuclear Corporation, Three Mile Island Group). 1994. Radiological environmental monitoring report for Three Mile Island Nuclear Station: 1993.

Heath, R.L. 1977. Gamma-ray Spectrum Catalogue, Ge(Li) and Si(Li) Spectrometry. Third edition. Aerojet Nuclear Company. ANCR-1000-2.

James, R.W., J.F. Hornlein, R.H. Simmons, and B.F. Strain. 1992. Water resources data Maryland and Delaware water year 1991. Volume 1. Surface-water data. U.S. Geological Survey Water-Data Report MD-DE-91-1. U.S. Geological Survey, Towson, MD.

James, R.W., R.H. Simmons, and B.F. Strain. 1993-1995. Water resources data Maryland and Delaware water year 1992-1994. Volume 1. Surface-water data. U.S. Geological Survey Water-Data Report MD-DE-92-94-1. U.S. Geological Survey, Towson, MD.

Kocher, D.C. 1977. Nuclear decay data for radionuclides occurring in routine releases from nuclear fuel cycle facilities. Oak Ridge National Laboratory, Oak Ridge, TN. ORNL NUREG TM-102.

Lippson, A.J. 1973. The Chesapeake Bay in Maryland: An Atlas of National Resources. Johns Hopkins University Press, Baltimore, MD.

Maranto, A.R. and R.I. McLean. 1993. Radiological impacts in Maryland from nuclear power production: 1989-1991. *In*: Maryland Power Plants and the Environment. PPRP-CEIR/8/2. March 1993. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

Martin Marietta Environmental Systems. 1985. The Effects of an Interim Minimum Flow from the Conowingo Dam on Fish Feeding and Benthos in the Susquehanna River, PPSP-UBLS-85-4. June, 1985. Maryland Department of Natural Resources, Power Plant Siting Program, Annapolis, MD.

McLean, R.I. and S.L. Domotor. 1988. Environmental radionuclide concentrations in the Vicinity of the Peach Bottom Atomic Power Station: 1981-1984. PPRP-R-9. March, 1988. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

McLean, R.I. and S.M. Long. 1978. Gamma-ray emitting radionuclide concentrations is selected environmental media from the vicinity of the Calvert Cliffs Nuclear Power Plant, PPSP-R-3. May, 1978. Maryland Department of Natural Resources, Power Plant Siting Program, Annapolis, MD.

NCRPM (National Council on Radiation Protection and Measurements). 1987. Exposure of the Population in the United States and Canada from Natural Background Radiation. NCRPM, Bethesda, MD.

NCRPM (National Council on Radiation Protection and Measurements). 1988. Ionizing radiation exposures of the population of the United States. NCRPM, Bethesda, MD.

NCRPM (National Council on Radiation Protection and Measurements). 1996. Sources and Magnitude of Occupational and Public Exposure from Nuclear Medicine Procedures. NCRPM, Bethesda, MD.

Olsen, C.R., I.L. Larsen, P.D. Lowry, R.I. McLean, and S.L. Domotor. 1989. Radionuclide Distributions and Sorption Behavior in the Susquehanna-Chesapeake Bay System, PPRP-R-12. January, 1989. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

PECO (Philadelphia Electric Company). 1980-1995. Semi-annual effluent reports for Peach Bottom Atomic Power Station, Units 2 and 3, January 1 - December 31, 1979-1994.

Ranasinghe, J.A., L.C. Scott, and S.B. Weisberg. 1996. Chesapeake Bay Water Quality Monitoring Program Long Term Benthic Monitoring and Assessment Component: Level 1 Comprehensive Report, July 1984 - December 1995. December, 1996. Versar, Inc., Columbia, MD.

Smith, A.R. and H.A. Wollenberg. 1972. High resolution gamma ray spectrometry for laboratory analysis of the uranium and thorium decay series. *In*: The Natural Radiation Environment II, Vol. 1. J.A. Adams, W.M. Lowder, and T.F. Gessel, eds. Proceedings of the Second Symposium on the Natural Radiation Environment.

Stanek, M.A. and R.I. McLean. 1995a. Environmental radionuclide concentrations in the vicinity of the Peach Bottom Atomic Power Station: 1987-1990. PPRP-R-19. December 20, 1995. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

Stanek, M.A. and R.I. McLean. 1995b. Radiological impacts in Maryland from nuclear power production: 1992-1993. *In*: Maryland Power Plants and the Environment. PPRP-CEIR-9/2. October, 1995. Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD.

USNRC (United States Nuclear Regulatory Commission). 1977. Calculation of annual doses to man from routine releases of reactor effluents for the purpose of evaluating compliance with 10 CFR Part 50, Appendix I. Regulatory Guide 1.109. Washington, DC: U.S. Government Printing Office.

USNRC (United States Nuclear Regulatory Commission). 1991. 10 CFR Part 20, Appendix B).

Whicker, F.W. and V. Schultz. 1982. Radioecology: Nuclear Energy and the Environment. Vol. 1. Boca Raton, FL: CRC Press, Inc.

APPENDIX A

COORDINATES OF SAMPLING STATIONS

SUSQUEHANNA RIVER/UPPER BAY SEDIMENT NETWORK

STATION	NAME/LOCATION	NORTH LATITUDE	WEST LONGITUDE
LYH-1	Little Yellow House	39°44.592′	76°15.120'
LYH-2		39°44.929′	76°14.635'
LYH-3		39°45.242'	76°14.082'
BC-1	Broad Creek	39°41.909'	76°14.017'
BC-2		39°42.044'	76°13.657'
BC-3		39°42.280'	76°13.063'
CONCK-1	Conowingo Creek	39°40.690'	76°12.327'
CONCK-2		39°40.848'	76°12.124'
CONCK-3		39°40.997'	76°11.996'
CONDAM-1	Conowingo Dam	39°39.475'	76°10.591'
CONDAM-2		39°39.675'	76°10.546'
CONDAM-3		39°40.026'	76°10.383'
SR-3	Susquehanna River (Rt. 95 Bridge)	39°34.858'	76°06.127'
SF-1	Susquehanna Flats (River Mouth (40'))	39°32.827'	76°04.467'
SF-6	Buoy R "14"	39°31.027'	76°05.007'
SF-7	Buoy N "12"	39°30.274'	76°05.216'
SF-8	Buoy N "8"	39°29.215'	76°04.955'
SF-9	Buoy N "2"	39°28.294'	76°03.261'
UB-10	Buoy RB "A"	39°26.555'	76°01.997'

Note:
Station #1 West
Station #2 Center of Reservoir
Station #3 East

APPENDIX B

INTERCOMPARISON RESULTS

Table B-1. Results of EPA Cross Check Program

Sample Date	Sample Type and Units	Radionuclide	Laboratory's Results (avg)	EPA's Results
02/08/91	Water-pCi/L	Co-60	37.00	40 ± 5
		Zn-65	147.67	149 ± 15
		Ru-106	179.30	286 ± 19
		Cs-134	8.00	8 ± 5
		Cs-137	7.67	8 ± 5
		Ba-133	71.00	75 ± 8
06/07/91	Water-pCi/L	Co-60	10.00	10 ± 5
		Zn-65	108.00	108 ± 11
		Ru-106	141.33	149 ± 15
		Cs-134	13.00	15 ± 5
		Cs-137	15.67	14 ± 5
		Ba-133	64.00	62 ± 6
02/14/92	Water-pCi/L	Co-60	40.33	40 ± 5
		Zn-65	146.00	148 ± 15
		Ru-106	180.00	203 ± 20
		Cs-134	30.00	31 ± 5
		Cs-137	49.67	49 ± 5
		Ba-133	74.67	76 ± 8
06/05/92	Water-pCi/L	Co-60	21.00	20 ± 5
		Zn-65	104.00	99 ± 10
		Ru-106	144.33	141 ± 14
		Cs-134	14.00	15 ± 5
		Cs-137	15.33	15 ± 5
		Ba-133	98.33	98 ± 10
06/11/93	Water-pCi/L	Co-60	13.67	15 ± 5
		Zn-65	107.33	103 ± 10
		Ru-106	90.67	119 ± 12
		Cs-134	4.67	5 ± 5
		Cs-137	6.33	5 ± 5
		Ba-133	100.00	99 ± 10
11/12/93	Water-pCi/L	Co-60	(1)	30 ± 5
		Zn-65	(1)	150 ± 15
		Ru-106	(1)	201 ± 20
		Cs-134	(1)	59 ± 5
		Cs-137	(1)	40 ± 5
		Ba-133	(1)	79 ± 8

Table B-1. Continued

Sample Date	Sample Type and Units	Radionuclide	Laboratory's Results (avg)	EPA's Results
06/10/94	Water-pCi/L	Co-60	(2)	50 ± 5
		Zn-65	(2)	134 ± 13
		Ru-106	(2)	252 ± 25
		Cs-134	(2)	40 ± 5
		Cs-137	(2)	49 ± 5
		Ba-133	(2)	98 ± 10
11/04/94	Water-pCi/L	Co-60	53.67	59 ± 5
		Zn-65	105.00	100 ± 10
		Ru-106	(3)	(3) (3)
		Cs-134	20.33	20.33 ± 5
		Cs-137	47.33	47.33 ± 5
		Ba-133	65.33	65.33 ± 7

Note:

(1) No data available. Analysis not performed by laboratory.

(2) The values reported to the EPA were incorrect. The detector efficiency pairs were off by a factor of two. The corrected results of 54, 156, 194, 39, 55, and 93 pCi/L are within the control limits and below the warning regions.

(3) The EPA notified participants that ^{106}Ru has been eliminated from the Performance Evaluation Studies until further notice.

APPENDIX C

CONCENTRATIONS OF RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

INTRODUCTION

This appendix contains data for most of the radionuclides detected in the environmental samples collected in the vicinity of the Peach Bottom Atomic Power Station during the 1991 through 1994 monitoring period. The radionuclides reported in these tables include the naturally occurring radionuclides ^{7}Be and ^{40}K, and the power plant produced radionuclides ^{110m}Ag, ^{58}Co, ^{60}Co, ^{134}Cs, ^{137}Cs, ^{95}Nb, ^{65}Zn, and ^{95}Zr. Radionuclide concentrations in sediments are reported as pCi/kg dry weight. Radionuclide concentrations in biological samples are reported as pCi/kg wet weight. Data are organized in the following tables:

Within each table, specific sample stations are arranged approximately north to south and data are presented by date along with annual and overall means for the entire four-year monitoring period. Data are decay corrected to the date of sample collection. Counting error is reported as +- 2-sigma error. Concentrations for radionuclides that were not detected in specific samples are recorded as less than (LT) the lower limit of detection for that sample as determined by spectrum analysis programs. Annual means were calculated as a simple arithmetic average of concentrations and variability was expressed as 2 standard deviation units. Overall means were calculated as the arithmetic average of annual means and variability was expressed as 2 standard deviation units. Lower limits of detection were excluded from mean calculations.

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7			K-40			Co-58			Co-60		
DATE	CONC		ERR	CONC		ERR	CONC		ERR	CONC		ERR
Station PBLYH010 - Peach Bottom Little Yellow House Station 1												
07/29/91		LT	74	5063	+-	142	LT	8			LT	10
10/10/91	87	+-	60	8597	+-	120	LT	5		79	+-	8
Yearly	87	+-	60	6830	+-	4998	--			79	+-	8
05/22/92		LT	191	7187	+-	187	LT	15		48	+-	13
10/08/92	49	+-	56	8050	+-	129	LT	6		44	+-	8
Yearly	49	+-	56	7619	+-	1220	--			46	+-	6
05/13/93	654	+-	230	9704	+-	155	LT	15		12	+-	7
09/16/93	95	+-	117	8372	+-	134	LT	11		18	+-	6
Yearly	375	+-	791	9038	+-	1884	--			15	+-	8
05/09/94		LT	59	17464	+-	175	LT	6			LT	6
09/22/94	40	+-	36	11169	+-	156	LT	4		49	+-	9
Yearly	40	+-	36	14317	+-	8902	--			49	+-	9
Overall	138	+-	318	9451	+-	6740	--			47	+-	52
Station PBLYH020 - Peach Bottom Little Yellow House Station 2												
07/29/91	68	+-	37	4999	+-	100	LT	4		LT	4	
10/10/91	67	+-	52	6295	+-	126	LT	5		LT	5	
Yearly	68	+-	1	5647	+-	1833	--			--		
05/22/92		LT	218	4526	+-	199	LT	17		LT	12	
10/08/92		LT	95	6173	+-	160	LT	9		LT	9	
Yearly		--		5350	+-	2329	--			--		
05/13/93		LT	154	4442	+-	98	LT	11		LT	4	
09/16/93	106	+-	12	6907	+-	124	LT	11		LT	5	
Yearly	106	+-	12	5675	+-	3486	--			--		
05/09/94	20	+-	27	4528	+-	72	LT	3		LT	3	
09/22/94	258	+-	46	11002	+-	132	LT	4		LT	5	
Yearly	139	+-	337	7765	+-	9156	--			--		
Overall	104	+-	72	6109	+-	2228	--			--		

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBLYH030 - Peach Bottom Little Yellow House Station 3								
07/29/91	LT 46		8576 +-	137	LT 4		8 +-	6
10/10/91	LT 207		12911 +-	413	LT 22		LT 21	
Yearly	--		10744 +-	6131	--		8 +-	6
05/22/92	98 +-	94	14393 +-	230	LT 9		LT 8	
10/08/92	LT 102		14803 +-	266	LT 10		LT 10	
Yearly	98 +-	94	14598 +-	580	--		--	
05/13/93	LT 316		11058 +-	221	LT 23		LT 8	
09/16/93	56 +-	149	7960 +-	143	LT 13		LT 6	
Yearly	56 +-	149	9509 +-	4381	--		--	
05/09/94	857 +-	129	15047 +-	181	LT 8		LT 8	
09/22/94	348 +-	63	11503 +-	184	LT 5		2 +-	5
Yearly	603 +-	720	13275 +-	5012	--		2 +-	5
Overall	252 +-	608	12031 +-	4641	--		5 +-	8
Station PBBRC010 - Peach Bottom Broad Creek Station 1								
07/29/91	59 +-	78	16478 +-	264	LT 9		19 +-	11
10/10/91	169 +-	114	17059 +-	307	LT 11		12 +-	10
Yearly	114 +-	156	16769 +-	822	--		16 +-	10
05/22/92	LT 150		17429 +-	279	LT 13		23 +-	14
10/08/92	LT 313		18998 +-	494	LT 39		LT 21	
Yearly	--		18214 +-	2219	--		23 +-	14
05/13/93	1244 +-	903	20706 +-	373	LT 63		LT 16	
09/16/93	LT 349		17990 +-	324	LT 26		LT 12	
Yearly	1244 +-	903	19348 +-	3841	--		--	
05/09/94	1105 +-	160	17183 +-	241	LT 10		LT 10	
09/22/94	853 +-	122	24958 +-	300	LT 9		18 +-	13
Yearly	979 +-	356	21071 +-	10996	--		18 +-	13
Overall	779 +-	1182	18850 +-	3636	--		19 +-	8

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBBRC020 - Peach Bottom Broad Creek Station 2								
07/29/91	220 +-	96	15222 +-	274	LT 9		LT 10	
10/10/91	140 +-	87	14219 +-	256	LT 9		LT 10	
Yearly	180 +-	113	14721 +-	1418	--		--	
05/22/92		LT 364	16222 +-	357	LT 29		LT 20	
10/08/92		LT 838	23912 +-	1387	LT 87		LT 68	
Yearly		--	20067 +-	10875	--		--	
05/13/93		LT 835	19905 +-	318	LT 52		LT 13	
09/16/93		LT 360	19159 +-	345	LT 27		LT 13	
Yearly		--	19532 +-	1055	--		--	
05/09/94	298 +-	90	14300 +-	200	LT 8		3 +-	6
09/22/94	416 +-	93	16587 +-	299	LT 8		14 +-	12
Yearly	357 +-	167	15444 +-	3234	--		9 +-	16
Overall	269 +-	250	17441 +-	5497	--		9 +-	16
Station PBBRC030 - Peach Bottom Broad Creek Station 3								
07/29/91	172 +-	97	14974 +-	270	LT 9		LT 10	
10/10/91		LT 255	12913 +-	465	LT 26		LT 26	
Yearly	172 +-	97	13944 +-	2915	--		--	
05/22/92	256 +-	173	16705 +-	301	LT 15		LT 12	
10/08/92		LT 138	15567 +-	280	LT 13		LT 11	
Yearly	256 +-	173	16136 +-	1609	--		--	
05/13/93		LT 810	14497 +-	261	LT 47		LT 11	
09/16/93		LT 442	17340 +-	347	LT 32		LT 15	
Yearly		--	15919 +-	4021	--		--	
05/09/94	858 +-	123	12244 +-	196	LT 8		LT 8	
09/22/94	594 +-	87	17698 +-	248	LT 7		LT 10	
Yearly	726 +-	373	14971 +-	7713	--		--	
Overall	385 +-	597	15242 +-	2005	--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
	Station PBCOC010 - Peach Bottom Conowingo Creek Station 1							
07/29/91	240 +-	212	13549 +-	461	LT 26		LT 25	
10/10/91	LT	170	12425 +-	422	LT 19		LT 23	
Yearly	240 +-	212	12987 +-	1590	--		--	
05/22/92	338 +-	478	17402 +-	452	LT 39		LT 25	
10/08/92	229 +-	135	16031 +-	289	LT 12		LT 12	
Yearly	284 +-	154	16717 +-	1939	--		--	
05/13/93	LT	748	16127 +-	323	LT 43		LT 12	
09/16/93	536 +-	328	14496 +-	290	LT 25		9 +-	8
Yearly	536 +-	328	15312 +-	2307	--		9 +-	8
05/09/94	2087 +-	185	15067 +-	241	LT 10		LT 10	
09/22/94	815 +-	116	18477 +-	333	LT 9		20 +-	13
Yearly	1451 +-	1799	16772 +-	4822	--		20 +-	13
Overall	628 +-	1128	15447 +-	3547	--		15 +-	16
	Station PBCOC020 - Peach Bottom Conowingo Creek Station 2							
07/29/91	LT	239	12037 +-	409	LT 25		LT 23	
10/10/91	406 +-	114	15447 +-	278	LT 10		LT 11	
Yearly	406 +-	114	13742 +-	4822	--		--	
05/22/92	349 +-	196	18164 +-	327	LT 16		14 +-	11
10/08/92	LT	255	18442 +-	480	LT 25		LT 28	
Yearly	349 +-	196	18303 +-	393	--		14 +-	11
05/13/93	2257 +-	644	17074 +-	273	LT 36		LT 10	
09/16/93	644 +-	352	18199 +-	328	LT 29		LT 13	
Yearly	1451 +-	2281	17637 +-	1591	--		--	
05/09/94	2017 +-	142	15385 +-	185	LT 9		LT 8	
09/22/94	724 +-	87	20800 +-	250	LT 7		19 +-	10
Yearly	1371 +-	1829	18093 +-	7658	--		19 +-	10
Overall	894 +-	1195	16944 +-	4305	--		17 +-	7

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBCOC030 - Peach Bottom Conowingo Creek Station 3								
07/29/91	LT 283		17550 +-	562	LT 31		LT 29	
10/10/91	LT 233		16460 +-	362	LT 21		LT 19	
Yearly	--		17005 +-	1541	--		--	
05/22/92	LT 378		18624 +-	372	LT 31		LT 21	
10/08/92	80 +-	79	15172 +-	243	LT 9		LT 9	
Yearly	80 +-	79	16898 +-	4882	--		--	
05/13/93	2226 +-	1001	18825 +-	376	LT 53		LT 14	
09/16/93	490 +-	416	15207 +-	335	LT 29		LT 13	
Yearly	1358 +-	2455	17016 +-	5117	--		--	
05/09/94	443 +-	134	16259 +-	260	LT 11		19 +-	14
09/22/94	810 +-	138	22145 +-	399	LT 12		LT 15	
Yearly	627 +-	519	19202 +-	8324	--		19 +-	14
Overall	688 +-	1282	17530 +-	2232	--		19 +-	14
Station PBCOD010 - Peach Bottom Conowingo Dam Station 1								
07/29/91	114 +-	105	16729 +-	301	LT 12		17 +-	11
10/10/91	54 +-	65	13716 +-	247	LT 8		LT 9	
Yearly	84 +-	85	15223 +-	4261	--		17 +-	11
05/22/92	LT 416		18660 +-	485	LT 35		LT 25	
10/08/92	146 +-	106	19791 +-	356	LT 10		LT 13	
Yearly	146 +-	106	19226 +-	1599	--		--	
05/13/93	1991 +-	514	17352 +-	278	LT 34		LT 11	
09/16/93	326 +-	294	13313 +-	240	LT 23		LT 10	
Yearly	1159 +-	2355	15333 +-	5712	--		--	
05/09/94	1229 +-	150	17645 +-	247	LT 12		LT 11	
09/22/94	698 +-	96	18858 +-	264	LT 7		17 +-	11
Yearly	964 +-	751	18252 +-	1715	--		17 +-	11
Overall	588 +-	1105	17008 +-	4076	--		18 +-	1

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBCOD020 - Peach Bottom Conowingo Dam Station 2								
07/29/91	340 +-	126	18069 +-	325	LT 11		LT 12	
10/10/91	134 +-	84	17089 +-	308	LT 9		LT 11	
Yearly	237 +-	291	17579 +-	1386	--		--	
05/22/92	227 +-	172	18868 +-	340	LT 16		LT 12	
10/08/92	154 +-	113	17381 +-	278	LT 11		LT 11	
Yearly	191 +-	103	18125 +-	2103	--		--	
05/13/93	2749 +-	768	18965 +-	341	LT 44		LT 12	
09/16/93	516 +-	303	15017 +-	240	LT 23		LT 10	
Yearly	1633 +-	3158	16991 +-	5583	--		--	
05/09/94	2444 +-	163	18549 +-	260	LT 11		LT 10	
09/22/94	803 +-	106	17001 +-	272	LT 9		LT 11	
Yearly	1624 +-	2321	17775 +-	2189	--		--	
Overall	921 +-	1633	17617 +-	949	--		--	
Station PBCOD030 - Peach Bottom Conowingo Dam Station 3								
07/29/91	121 +-	112	18642 +-	298	LT 12		6 +-	8
10/10/91	LT 91		13983 +-	224	LT 9		LT 9	
Yearly	121 +-	112	16313 +-	6589	--		6 +-	8
05/22/92	LT 456		19018 +-	456	LT 37		LT 25	
10/08/92	LT 90		19832 +-	357	LT 9		16 +-	11
Yearly	--		19425 +-	1151	--		16 +-	11
05/13/93	660 +-	707	19878 +-	358	LT 48		LT 14	
09/16/93	LT 353		17039 +-	273	LT 27		LT 11	
Yearly	660 +-	707	18459 +-	4015	--		--	
05/09/94	385 +-	121	18475 +-	259	LT 11		20 +-	10
09/22/94	516 +-	94	19765 +-	277	LT 8		10 +-	8
Yearly	451 +-	185	19120 +-	1824	--		15 +-	14
Overall	411 +-	543	18329 +-	2807	--		12 +-	11

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
	Station PBSRV030 - Peach Bottom Susquehanna River Station 3							
07/29/91	26 +-	23	4798 +-	86	LT 3		LT 3	
10/10/91	LT	97	5927 +-	130	LT 9		LT 7	
Yearly	26 +-	23	5363 +-	1597	--		--	
05/22/92	96 +-	56	6048 +-	109	LT 5		LT 4	
10/08/92	LT	101	4802 +-	125	LT 9		LT 6	
Yearly	96 +-	56	5425 +-	1762	--		--	
05/13/93	LT	141	3521 +-	84	LT 10		LT 3	
09/16/93	LT	115	3041 +-	73	LT 8		LT 3	
Yearly	--		3281 +-	679	--		--	
05/09/94	129 +-	35	3533 +-	57	LT 3		LT 2	
09/22/94	59 +-	29	6133 +-	98	LT 3		LT 4	
Yearly	94 +-	99	4833 +-	3677	--		--	
Overall	72 +-	80	4725 +-	1998	--		--	
	Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1							
07/29/91	LT	52	1896 +-	80	LT 5		LT 5	
10/10/91	76 +-	50	2452 +-	78	LT 5		LT 4	
Yearly	76 +-	50	2174 +-	786	--		--	
05/22/92	150 +-	58	4034 +-	89	LT 4		LT 2	
10/08/92	LT	99	4933 +-	138	LT 9		LT 7	
Yearly	150 +-	58	4484 +-	1271	--		--	
05/13/93	LT	163	2605 +-	73	LT 10		LT 3	
09/16/93	106 +-	90	2994 +-	72	LT 8		LT 3	
Yearly	106 +-	90	2800 +-	550	--		--	
05/09/94	65 +-	30	2616 +-	52	LT 3		LT 2	
09/22/94	45 +-	22	3239 +-	58	LT 2		LT 2	
Yearly	55 +-	28	2928 +-	881	--		--	
Overall	97 +-	82	3096 +-	1964	--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBSFL060 - Peach Bottom Susquehanna Flat Station 6								
07/29/91	128 +-	69	2578 +-	98	LT 5		LT 6	
10/10/91	112 +-	63	3753 +-	105	LT 6		LT 6	
Yearly	120 +-	23	3166 +-	1662	--		--	
05/22/92	LT 149		5563 +-	156	LT 12		LT 9	
10/08/92	LT 67		2631 +-	84	LT 6		LT 4	
Yearly	--		4097 +-	4146	--		--	
05/13/93	LT 147		2928 +-	70	LT 9		LT 3	
09/16/93	104 +-	114	3855 +-	93	LT 10		LT 4	
Yearly	104 +-	114	3392 +-	1311	--		--	
05/09/94	88 +-	37	4316 +-	69	LT 4		LT 3	
09/22/94	51 +-	30	3513 +-	70	LT 2		LT 3	
Yearly	70 +-	52	3915 +-	1136	--		--	
Overall	98 +-	52	3642 +-	873	--		--	
Station PBSFL070 - Peach Bottom Susquehanna Flat Station 7								
07/29/91	LT 56		1634 +-	78	LT 5		LT 5	
10/10/91	218 +-	84	3927 +-	118	LT 8		LT 7	
Yearly	218 +-	84	2781 +-	3243	--		--	
05/22/92	LT 113		2959 +-	101	LT 9		LT 6	
10/14/92	70 +-	71	3335 +-	113	LT 6		LT 6	
Yearly	70 +-	71	3147 +-	532	--		--	
05/13/93	LT 151		2652 +-	76	LT 9		LT 3	
09/16/93	97 +-	97	3158 +-	76	LT 8		LT 3	
Yearly	97 +-	97	2905 +-	716	--		--	
05/09/94	58 +-	36	3064 +-	61	LT 3		LT 3	
09/22/94	78 +-	21	3009 +-	54	LT 2		2 +-	2
Yearly	68 +-	28	3037 +-	78	--		2 +-	2
Overall	113 +-	142	2967 +-	318	--		2 +-	2

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBSFL080 - Peach Bottom Susquehanna Flat Station 8								
07/29/91	109 +-	67	3122 +-	112	LT 7		LT 6	
10/10/91	301 +-	116	6099 +-	146	LT 9		LT 8	
Yearly	205 +-	272	4611 +-	4210	--		--	
05/22/92	LT	168	5260 +-	147	LT 12		LT 8	
10/08/92	100 +-	49	4452 +-	98	LT 4		LT 4	
Yearly	100 +-	49	4856 +-	1143	--		--	
05/13/93	LT	200	3716 +-	82	LT 12		LT 4	
09/16/93	LT	179	4852 +-	107	LT 12		LT 4	
Yearly	--		4284 +-	1607	--		--	
05/09/94	66 +-	38	3933 +-	79	LT 4		LT 3	
09/22/94	189 +-	43	5111 +-	102	LT 4		LT 4	
Yearly	128 +-	174	4522 +-	1666	--		--	
Overall	144 +-	109	4568 +-	473	--		--	
Station PBSFL090 - Peach Bottom Susquehanna Flat Station 9								
07/29/91	96 +-	90	4734 +-	151	LT 9		LT 9	
10/10/91	LT	125	5557 +-	144	LT 10		LT 8	
Yearly	96 +-	90	5146 +-	1164	--		--	
05/22/92	176 +-	91	6833 +-	123	LT 7		LT 5	
10/08/92	134 +-	140	8426 +-	219	LT 14		LT 11	
Yearly	155 +-	59	7630 +-	2253	--		--	
05/13/93	532 +-	372	11991 +-	240	LT 27		LT 9	
09/16/93	327 +-	223	7407 +-	148	LT 16		LT 6	
Yearly	430 +-	290	9699 +-	6483	--		--	
05/09/94	LT	44	11877 +-	143	LT 4		LT 3	
09/22/94	384 +-	69	10743 +-	150	LT 5		LT 6	
Yearly	384 +-	69	11310 +-	1604	--		--	
Overall	266 +-	330	8446 +-	5333	--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Be-7		K-40		Co-58		Co-60	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
	Station PBUPB100 - Peach Bottom Upper Bay Station 10							
07/29/91	LT	92	5289 +-	180	LT 9		LT 10	
10/10/91	180 +-	116	8198 +-	197	LT 13		LT 10	
Yearly	180 +-	116	6744 +-	4114	--		--	
05/22/92	63 +-	73	7481 +-	135	LT 7		LT 5	
10/08/92	LT	280	9981 +-	539	LT 28		LT 24	
Yearly	63 +-	73	8731 +-	3536	--		--	
05/13/93	LT	356	9074 +-	163	LT 24		LT 7	
09/16/93	198 +-	203	9038 +-	163	LT 17		LT 7	
Yearly	198 +-	203	9056 +-	51	--		--	
05/09/94	LT	49	14711 +-	177	LT 4		7 +-	4
09/22/94	LT	63	11344 +-	204	LT 6		LT	8
Yearly	--		13028 +-	4762	--		7 +-	4
Overall	147 +-	147	9390 +-	5264	--		7 +-	4

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBLYH010 - Peach Bottom Little Yellow House Station 1										
07/29/91	LT 7		68 +-	9	LT 17		LT 17		LT 21	
10/10/91	9 +-	4	147 +-	4	LT 24		LT 11		LT 4	
Yearly	9 +-	4	108 +-	112	--		--		--	
05/22/92	LT 15		132 +-	17	LT 20		LT 29		LT 46	
10/08/92	4 +-	4	86 +-	7	LT 50		LT 11		LT 17	
Yearly	4 +-	4	109 +-	65	--		--		--	
05/13/93	LT 5		98 +-	6	LT 20		LT 15		LT 64	
09/16/93	LT 4		60 +-	5	LT 84		LT 13		LT 31	
Yearly	--		79 +-	54	--		--		--	
05/09/94	LT 5		3 +-	6	LT 8		LT 12		LT 16	
09/22/94	LT 4		164 +-	6	LT 6		17 +-	16	LT 12	
Yearly	--		84 +-	228	--		17 +-	16	--	
Overall	7 +-	7	95 +-	31	--		17 +-	16	--	
Station PBLYH020 - Peach Bottom Little Yellow House Station 2										
07/29/91	LT 3		33 +-	4	LT 4		LT 7		LT 6	
10/10/91	LT 4		54 +-	5	LT 28		LT 10		LT 6	
Yearly	--		44 +-	30	--		--		--	
05/22/92	LT 22		69 +-	18	LT 24		123 +-	30	LT 58	
10/08/92	LT 14		53 +-	14	LT 40		LT 156		LT 27	
Yearly	--		61 +-	23	--		123 +-	30	--	
05/13/93	LT 3		18 +-	3	LT 14		LT 10		LT 30	
09/16/93	LT 4		46 +-	4	LT 82		LT 13		LT 36	
Yearly	--		32 +-	40	--		--		--	
05/09/94	LT 2		16 +-	3	LT 4		LT 6		LT 10	
09/22/94	LT 4		90 +-	5	LT 5		LT 10		LT 10	
Yearly	--		53 +-	105	--		--		--	
Overall	--		47 +-	25	--		123 +-	30	--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBLYH030 - Peach Bottom Little Yellow House Station 3										
07/29/91	LT 4		104	+- 5	LT 5		LT 10		LT 7	
10/10/91	LT 15		160	+- 24	LT 25		LT 42		LT 54	
Yearly	--		132	+- 79	--		--		--	
05/22/92	LT 6		164	+- 7	LT 12		LT 17		LT 8	
10/08/92	LT 7		192	+- 7	LT 71		LT 20		LT 28	
Yearly	--		178	+- 40	--		--		--	
05/13/93	LT 7		110	+- 7	LT 28		LT 22		LT 67	
09/16/93	LT 5		55	+- 6	LT 19		LT 14		LT 55	
Yearly	--		83	+- 78	--		--		--	
05/09/94	LT 6		151	+- 6	LT 9		LT 15		LT 20	
09/22/94	LT 5		122	+- 6	LT 7		LT 14		LT 13	
Yearly	--		137	+- 41	--		--		--	
Overall	--		132	+- 78	--		--		--	
Station PBBRC010 - Peach Bottom Broad Creek Station 1										
07/29/91	LT 7		264	+- 13	LT 11		LT 19		LT 12	
10/10/91	LT 8		274	+- 9	LT 47		LT 22		LT 10	
Yearly	--		269	+- 14	--		--		--	
05/22/92	LT 8		281	+- 10	LT 16		LT 22		LT 52	
10/08/92	LT 19		360	+- 37	LT 30		LT 45		LT 67	
Yearly	--		321	+- 112	--		--		--	
05/13/93	LT 13		294	+- 19	LT 83		LT 44		LT 281	
09/16/93	LT 9		238	+- 11	LT 203		LT 30		LT 85	
Yearly	--		266	+- 79	--		--		--	
05/09/94	LT 8		206	+- 9	LT 12		LT 19		LT 43	
09/22/94	LT 8		222	+- 11	LT 11		LT 22		LT 22	
Yearly	--		214	+- 23	--		--		--	
Overall	--		267	+- 87	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBBRC020 - Peach Bottom Broad Creek Station 2										
07/29/91	LT 7		201	+- 14	LT 11		LT 20		LT 13	
10/10/91	LT 7		203	+- 8	LT 12		LT 18		LT 6	
Yearly	--		202	+- 3	--		--		+-	
05/22/92	LT 25		236	+- 15	LT 38		LT 53		LT 94	
10/08/92	LT 54		343	+- 91	LT 89		LT 130		LT 193	
Yearly	--		290	+- 151	--		--		--	
05/13/93	LT 10		269	+- 10	LT 70		LT 36		LT 149	
09/16/93	LT 9		251	+- 11	LT 188		LT 33		LT 79	
Yearly	--		260	+- 25	--		--		--	
05/09/94	LT 6		165	+- 7	LT 10		LT 16		LT 21	
09/22/94	LT 8		220	+- 9	LT 10		13	+- 29	LT 21	
Yearly	--		193	+- 78	--		13	+- 29	--	
Overall	--		236	+- 93	--		13	+- 29	--	
Station PBBRC030 - Peach Bottom Broad Creek Station 3										
07/29/91	LT 7		202	+- 13	LT 11		LT 19		LT 9	
10/10/91	LT 19		174	+- 31	LT 32		LT 53		LT 70	
Yearly	--		188	+- 40	--		--		--	
05/22/92	LT 8		232	+- 15	LT 19		LT 24		LT 30	
10/08/92	LT 8		221	+- 10	LT 88		LT 23		LT 38	
Yearly	--		227	+- 16	--		--		--	
05/13/93	LT 9		178	+- 8	LT 65		LT 33		LT 202	
09/16/93	LT 11		186	+- 14	LT 263		LT 36		LT 100	
Yearly	--		182	+- 11	--		--		--	
05/09/94	LT 6		122	+- 8	LT 10		LT 15		LT 21	
09/22/94	LT 7		193	+- 10	LT 9		LT 17		LT 25	
Yearly	--		158	+- 100	--		--		--	
Overall	--		189	+- 57	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
	Station PBCOC010 - Peach Bottom Conowingo Creek Station 1									
07/29/91	LT	19	172 +-	29	LT	45	LT	56	LT	76
10/10/91	LT	17	180 +-	25	LT	51	LT	46	LT	53
Yearly	--		176 +-	11	--		--		--	
05/22/92	LT	30	275 +-	33	LT	51	LT	64	LT	125
10/08/92	LT	8	250 +-	10	LT	66	LT	22	LT	32
Yearly	--		263 +-	35	--		--		--	
05/13/93	LT	9	223 +-	9	LT	305	LT	34	LT	149
09/16/93	LT	9	191 +-	14	LT	181	LT	30	LT	76
Yearly	--		207 +-	45	--		--		--	
05/09/94	LT	8	177 +-	8	LT	12	LT	19	LT	26
09/22/94	LT	9	244 +-	11	LT	11	37 +-	32	LT	24
Yearly	--		211 +-	95	--		37 +-	32	--	
Overall	--		214 +-	72	--		37 +-	32	--	
	Station PBCOC020 - Peach Bottom Conowingo Creek Station 2									
07/29/91	LT	18	158 +-	28	LT	30	LT	52	LT	69
10/10/91	LT	8	214 +-	15	LT	43	LT	21	LT	13
Yearly	--		186 +-	79	--		--		--	
05/22/92	LT	8	267 +-	10	LT	19	LT	26	LT	46
10/08/92	LT	34	273 +-	15	LT	39	LT	64	LT	67
Yearly	--		270 +-	8	--		--		--	
05/13/93	LT	8	205 +-	11	LT	348	LT	29	LT	120
09/16/93	LT	9	228 +-	10	LT	232	LT	32	LT	92
Yearly	--		217 +-	33	--		--		--	
05/09/94	LT	6	168 +-	6	LT	11	LT	16	LT	22
09/22/94	LT	7	195 +-	9	LT	9	26 +-	24	LT	18
Yearly	--		182 +-	38	--		26 +-	24	--	
Overall	--		214 +-	81	--		26 +-	24	--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBCOC030 - Peach Bottom Conowingo Creek Station 3										
07/29/91	LT 21		181 +-	33	LT 37		LT 64		LT 89	
10/10/91	LT 21		211 +-	27	LT 26		LT 45		LT 65	
Yearly	--		196 +-	42	--		--		--	
05/22/92	LT 23		211 +-	26	LT 44		LT 52		LT 99	
10/08/92	LT 6		142 +-	8	LT 61		LT 18		LT 26	
Yearly	--		177 +-	98	--		--		--	
05/13/93	LT 11		246 +-	12	LT 341		LT 42		LT 180	
09/16/93	LT 10		205 +-	14	LT 213		LT 33		LT 73	
Yearly	--		226 +-	58	--		--		--	
05/09/94	LT 8		212 +-	8	LT 14		LT 21		LT 37	
09/22/94	LT 11		229 +-	18	LT 14		LT 28		LT 28	
Yearly	--		221 +-	24	--		--		--	
Overall	--		205 +-	46	--		--		--	
Station PBCOD010 - Peach Bottom Conowingo Dam Station 1										
07/29/91	LT 8		272 +-	15	LT 13		LT 21		LT 8	
10/10/91	LT 6		210 +-	7	LT 9		LT 16		LT 18	
Yearly	--		241 +-	88	--		--		--	
05/22/92	LT 45		209 +-	25	LT 42		LT 64		LT 108	
10/08/92	LT 9		272 +-	10	LT 64		LT 23		LT 27	
Yearly	--		241 +-	89	--		--		--	
05/13/93	LT 8		233 +-	11	LT 288		LT 30		LT 105	
09/16/93	LT 7		168 +-	9	LT 194		LT 24		LT 67	
Yearly	--		201 +-	92	--		--		--	
05/09/94	10 +-	13	209 +-	9	LT 14		LT 21		LT 10	
09/22/94	LT 7		202 +-	6	LT 9		LT 18		LT 18	
Yearly	10 +-	13	206 +-	10	--		--		--	
Overall	10 +-	13	222 +-	44	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Station PBCOD020 - Peach Bottom Conowingo Dam Station 2										
07/29/91	LT 8		245	+- 8	LT 13		LT 22		LT 13	
10/10/91	LT 8		236	+- 15	LT 11		LT 20		LT 21	
Yearly	--		241	+- 13	--		--		--	
05/22/92	LT 8		259	+- 11	LT 20		LT 25		LT 76	
10/08/92	LT 8		234	+- 12	LT 74		LT 21		LT 32	
Yearly	--		247	+- 35	--		--		--	
05/13/93	LT 9		256	+- 11	LT 339		LT 36		LT 142	
09/16/93	LT 8		178	+- 10	LT 184		LT 25		LT 77	
Yearly	--		217	+- 110	--		--		--	
05/09/94	LT 8		218	+- 7	LT 14		LT 20		LT 39	
09/22/94	LT 8		214	+- 11	LT 10		LT 22		LT 22	
Yearly	--		216	+- 6	--		--		--	
Overall	--		230	+- 32	--		--		--	
Station PBCOD030 - Peach Bottom Conowingo Dam Station 3										
07/29/91	LT 8		266	+- 10	LT 14		LT 23		LT 14	
10/10/91	LT 6		156	+- 6	LT 11		LT 16		LT 7	
Yearly	--		211	+- 156	--		--		--	
05/22/92	LT 30		287	+- 13	LT 47		LT 64		LT 115	
10/08/92	LT 9		301	+- 11	LT 67		LT 24		LT 21	
Yearly	--		294	+- 20	--		--		--	
05/13/93	LT 10		264	+- 135	LT 334		LT 40		LT 169	
09/16/93	LT 8		197	+- 13	LT 198		LT 28		LT 80	
Yearly	--		231	+- 95	--		--		--	
05/09/94	LT 7		222	+- 7	LT 13		LT 19		LT 28	
09/22/94	LT 7		214	+- 13	LT 9		LT 18		LT 20	
Yearly	--		218	+- 11	--		--		--	
Overall	--		238	+- 76	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBSRV030 - Peach Bottom Susquehanna River Station 3										
07/29/91	LT 2		8	+- 3	LT 3		LT 6		LT 4	
10/10/91	LT 8		LT 7		LT 11		LT 17		LT 27	
Yearly	--		8	+- 3	--		--		--	
05/22/92	LT 3		10	+- 4	LT 6		LT 8		LT 10	
10/08/92	LT 6		16	+- 8	LT 9		LT 13		LT 21	
Yearly	--		13	+- 8	--		--		--	
05/13/93	LT 3		6	+- 3	LT 53		LT 9		LT 30	
09/16/93	LT 3		12	+- 2	LT 44		LT 8		LT 18	
Yearly	--		9	+- 8	--		--		--	
05/09/94	LT 2		13	+- 2	LT 3		LT 5		LT 8	
09/22/94	LT 3		8	+- 4	LT 4		LT 7		LT 8	
Yearly	--		11	+- 7	--		--		--	
Overall	--		10	+- 4	--		--		--	
Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1										
07/29/91	LT 4		15	+- 5	LT 6		LT 10		LT 14	
10/10/91	LT 5		17	+- 7	LT 6		LT 10		LT 13	
Yearly	--		16	+- 3	--		--		--	
05/22/92	LT 3		36	+- 4	LT 5		LT 7		LT 18	
10/08/92	LT 6		62	+- 13	LT 10		LT 14		LT 21	
Yearly	--		49	+- 37	--		--		--	
05/13/93	LT 3		8	+- 3	LT 53		LT 9		LT 31	
09/16/93	LT 2		12	+- 3	LT 42		LT 8		LT 22	
Yearly	--		10	+- 6	--		--		--	
05/09/94	LT 2		6	+- 2	LT 3		LT 4		LT 6	
09/22/94	LT 2		8	+- 2	LT 2		LT 4		LT 3	
Yearly	--		7	+- 3	--		--		--	
Overall	--		21	+- 39	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBSFL060 - Peach Bottom Susquehanna Flat Station 6										
07/29/91	LT 5		34 +-	7	LT 7		LT 12		LT 15	
10/10/91	LT 7		21 +-	8	LT 20		LT 13		LT 9	
Yearly	--		28 +-	18	--		--		--	
05/22/92	LT 13		106 +-	16	LT 15		LT 24		LT 38	
10/08/92	LT 4		12 +-	6	LT 6		LT 9		LT 14	
Yearly	--		59 +-	133	--		--		--	
05/13/93	LT 2		13 +-	3	LT 53		LT 8		LT 28	
09/16/93	LT 3		18 +-	4	LT 54		LT 10		LT 23	
Yearly	--		16 +-	7	--		--		--	
05/09/94	LT 3		21 +-	2	LT 5		LT 6		LT 12	
09/22/94	LT 2		33 +-	3	LT 3		LT 5		LT 6	
Yearly	--		27 +-	17	--		--		--	
Overall	--		32 +-	37	--		--		--	
Station PBSFL070 - Peach Bottom Susquehanna Flat Station 7										
07/29/91	LT 5		9 +-	6	LT 6		LT 11		LT 15	
10/10/91	LT 8		57 +-	10	LT 10		LT 16		LT 7	
Yearly	--		33 +-	68	--		--		--	
05/22/92	LT 11		LT 6		LT 11		LT 14		LT 26	
10/14/92	LT 5		18 +-	7	LT 7		LT 11		LT 15	
Yearly	--		18 +-	7	--		--		--	
05/13/93	LT 3		16 +-	4	LT 58		LT 8		LT 29	
09/16/93	LT 3		24 +-	3	LT 44		LT 8		LT 24	
Yearly	--		20 +-	11	--		--		--	
05/09/94	LT 2		10 +-	2	LT 4		LT 6		LT 5	
09/22/94	LT 2		14 +-	2	LT 2		LT 4		LT 5	
Yearly	--		12 +-	6	--		--		--	
Overall	--		21 +-	18	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBSFL080 - Peach Bottom Susquehanna Flat Station 8										
07/29/91	LT 6		31 +-	7	LT 12		LT 15		LT 21	
10/10/91	LT 11		89 +-	12	12 +-	12	LT 19		LT 29	
Yearly	--		60 +-	82	12 +-	12	--		--	
05/22/92	LT 11		72 +-	13	LT 39		LT 22		LT 41	
10/08/92	LT 3		42 +-	5	LT 30		LT 8		LT 12	
Yearly	--		57 +-	42	--		--		--	
05/13/93	LT 3		33 +-	4	LT 87		LT 9		LT 34	
09/16/93	LT 4		42 +-	4	LT 91		LT 12		LT 37	
Yearly	--		38 +-	13	--		--		--	
05/09/94	LT 3		19 +-	3	LT 5		LT 6		LT 9	
09/22/94	LT 3		38 +-	5	LT 4		LT 8		LT 9	
Yearly	--		29 +-	27	--		--		--	
Overall	--		46 +-	30	12 +-	12	--		--	
Station PBSFL090 - Peach Bottom Susquehanna Flat Station 9										
07/29/91	LT 8		45 +-	10	LT 24		LT 20		LT 26	
10/10/91	LT 10		69 +-	12	LT 13		LT 19		LT 32	
Yearly	--		57 +-	34	--		--		--	
05/22/92	LT 4		80 +-	4	LT 10		LT 11		LT 19	
10/08/92	LT 10		140 +-	18	LT 16		LT 23		LT 36	
Yearly	--		110 +-	85	--		--		--	
05/13/93	LT 7		133 +-	8	LT 196		LT 25		LT 89	
09/16/93	LT 5		84 +-	6	LT 126		LT 16		LT 45	
Yearly	--		109 +-	69	--		--		--	
05/09/94	LT 3		15 +-	3	LT 5		LT 7		LT 11	
09/22/94	LT 4		113 +-	6	LT 6		LT 11		LT 12	
Yearly	--		64 +-	139	--		--		--	
Overall	--		85 +-	57	--		--		--	

Table 1. Radionuclide Concentrations in Sediments (pCi/kg +- 2 sigma error)

	Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
	Station PBUPB100 - Peach Bottom Upper Bay Station 10									
07/29/91	LT 8		82 +-	16	LT 12		LT 21		LT 28	
10/10/91	LT 13		124 +-	16	LT 16		LT 25		LT 39	
Yearly	--		103 +-	59	--		--		--	
05/22/92	LT 4		95 +-	5	LT 9		LT 11		LT 14	
10/08/92	LT 20		126 +-	30	LT 73		LT 54		LT 74	
Yearly	--		111 +-	44	--		--		--	
05/13/93	LT 5		119 +-	6	LT 234		LT 18		LT 76	
09/16/93	LT 5		106 +-	6	LT 25		LT 15		LT 50	
Yearly	--		113 +-	18	--		--		--	
05/09/94	LT 3		89 +-	3	LT 6		LT 7		LT 12	
09/22/94	LT 5		206 +-	7	LT 8		LT 14		LT 17	
Yearly	--		148 +-	165	--		--		--	
Overall	--		118 +-	40	--		--		--	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Be-7 CONC	Be-7 ERR	K-40 CONC	K-40 ERR	Co-58 CONC	Co-58 ERR	Co-60 CONC	Co-60 ERR
					Station PBLYH010 - Peach Bottom Little Yellow House Station 1					
Carpoides cyprinus	flesh	07/29/91	LT 161		2632 +-	179	LT 18		LT 15	
Cyprinus carpio	flesh	07/29/91	LT 33		2273 +-	82	LT 4		LT 4	
Cyprinus carpio	flesh	10/10/91	LT 40		2534 +-	81	LT 4		LT 3	
Ictalurus punctatus	flesh	07/29/91	LT 51		2225 +-	125	LT 5		LT 5	
Ictalurus punctatus	flesh	10/10/91	LT 27		2582 +-	93	LT 3		LT 3	
M. saxatalis + M. chrysops	flesh	10/10/91	LT 32		2635 +-	69	LT 3		LT 3	
Micropterus dolomieu	flesh	07/29/91	LT 36		2885 +-	133	LT 5		LT 5	
Micropterus dolomieu	flesh	10/10/91	LT 165		3906 +-	211	LT 16		LT 12	
	flesh	Yearly	--		2709 +-	1055	--		--	
Carpoides cyprinus	flesh	05/21/92	LT 134		3889 +-	233	LT 14		LT 13	
Carpoides cyprinus	flesh	10/14/92	LT 46		2869 +-	126	LT 5		LT 6	
Cyprinus carpio	flesh	05/21/92	LT 70		2698 +-	130	LT 8		LT 7	
Cyprinus carpio	flesh	10/14/92	LT 47		2651 +-	111	LT 5		LT 5	
Ictalurus punctatus	flesh	10/14/92	LT 92		2569 +-	123	LT 9		LT 7	
Ictalurus sp.	flesh	05/21/92	LT 140		3244 +-	208	LT 14		LT 13	
Lepomis gibbosus	flesh	05/21/92	LT 72		2836 +-	164	LT 7		LT 8	
M. saxatalis + M. chrysops	flesh	10/14/92	LT 30		2958 +-	95	LT 4		LT 3	
Micropterus dolomieu	flesh	05/21/92	LT 32		2432 +-	102	LT 4		LT 4	
Micropterus dolomieu	flesh	10/14/92	LT 28		2856 +-	103	LT 3		LT 4	
Micropterus salmoides	flesh	05/21/92	LT 55		3981 +-	167	LT 6		LT 7	
Micropterus salmoides	flesh	10/14/92	LT 23		2587 +-	93	LT 3		LT 4	
Porosoma cepedianum	flesh	05/21/92	LT 63		2629 +-	110	LT 6		LT 6	
	flesh	Yearly	--		2938 +-	976	--		--	
Carpoides cyprinus	flesh	05/12/93	LT 3847		4067 +-	228	LT 170		LT 12	
Carpoides cyprinus	flesh	09/16/93	LT 300		1512 +-	79	LT 20		LT 4	
Cyprinus carpio	flesh	05/12/93	LT 53		2367 +-	85	LT 5		LT 4	
Cyprinus carpio	flesh	09/16/93	LT 351		3221 +-	116	LT 23		LT 6	
Ictalurus punctatus	flesh	05/12/93	LT 1300		3252 +-	130	LT 66		LT 6	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

			Be-7		K-40		Co-58		Co-60	
SPECIES	TYPE	DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Ictalurus punctatus	flesh	09/16/93	LT 651		2720	+- 147	LT 42		LT 8	
Lepomis gibbosus	flesh	05/12/93	LT 3689		2484	+- 184	LT 161		LT 11	
Lepomis macrochirus	flesh	05/12/93	LT 3249		3558	+- 221	LT 154		LT 11	
Micropterus dolomieu	flesh	05/12/93	LT 3045		3728	+- 201	LT 135		LT 9	
Micropterus dolomieu	flesh	09/16/93	LT 194		1731	+- 62	LT 12		LT 3	
Micropterus salmoides	flesh	05/12/93	LT 75		3271	+- 118	LT 7		LT 5	
Micropterus salmoides	flesh	09/16/93	LT 238		1374	+- 69	LT 15		LT 3	
Notropis sp.	flesh	05/12/93	LT 5006		1121	+- 119	LT 215		LT 12	
Pomoxis sp.	flesh	05/12/93	LT 4998		3960	+- 238	LT 206		LT 13	
Porosoma cepedianum	flesh	05/12/93	LT 2981		1394	+- 100	LT 131		LT 6	
Porosoma cepedianum	flesh	09/16/93	LT 637		3034	+- 152	LT 39		LT 8	
Porosoma cepedianum	flesh	09/16/93	LT 394		3073	+- 111	LT 25		LT 6	
Moxostoma spp.	flesh	05/12/93	LT 3085		3929	+- 189	LT 123		LT 10	
Moxostoma spp.	flesh	09/16/93	LT 644		659	+- 74	LT 44		LT 7	
Lepomis spp.	flesh	09/16/93	LT 1194		2567	+- 195	LT 76		LT 12	
	flesh	Yearly	--		2651	+- 2078	--		--	
Carpoides cyprinus	flesh	05/10/94	LT 52		2738	+- 99	LT 6		LT 6	
Cyprinus carpio	flesh	05/10/94	LT 13		1801	+- 54	LT 2		LT 2	
Cyprinus carpio	flesh	09/23/94	LT 22		3502	+- 84	LT 3		LT 3	
Ictalurus punctatus	flesh	05/10/94	LT 24		3108	+- 87	LT 3		LT 4	
Micropterus dolomieu	flesh	05/10/94	LT 22		2998	+- 78	LT 3		LT 3	
Micropterus dolomieu	flesh	09/23/94	LT 23		3484	+- 84	LT 3		LT 3	
Micropterus salmoides	flesh	05/10/94	LT 16		2292	+- 64	LT 2		LT 3	
Micropterus salmoides	flesh	09/23/94	LT 21		1763	+- 60	LT 3		LT 2	
Porosoma cepedianum	flesh	05/10/94	LT 26		2401	+- 67	LT 3		LT 4	
Porosoma cepedianum	flesh	09/23/94	67	+- 34	2327	+- 84	LT 3		LT 4	
Moxostoma spp.	flesh	09/23/94	LT 31		3781	+- 98	LT 4		LT 4	
Stizostedion vitreum	flesh	05/10/94	LT 38		2830	+- 85	LT 4		LT 5	
Lepomis spp.	flesh	05/10/94	LT 44		2893	+- 98	LT 5		LT 5	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Be-7 CONC	Be-7 ERR	K-40 CONC	K-40 ERR	Co-58 CONC	Co-58 ERR	Co-60 CONC	Co-60 ERR
Lepomis spp.	flesh	09/23/94	LT 23		1716	+- 58	LT 2		LT 2	
	flesh	Yearly	67	+- 34	2688	+- 1334	--		--	
	flesh	Overall	67	+- 34	2747	+- 260	--		--	
Carpoides cyprinus	gut	07/29/91	LT 1639		375	+- 39	LT 171		LT 140	
Cyprinus carpio	gut	07/29/91	LT 431		1870	+- 262	LT 40		LT 31	
Cyprinus carpio	gut	10/10/91	LT 12065		3744	+- 502	LT 529		LT 64	
Ictalurus punctatus	gut	07/29/91	LT 2004		1897	+- 250	LT 144		LT 36	
Ictalurus punctatus	gut	10/10/91	LT 1923		5285	+- 645	LT 160		LT 69	
M. saxatalis + M. chrysops	gut	10/10/91	LT 5034		69	+- 13	LT 244		LT 32	
Micropterus dolomieu	gut	07/29/91	LT 2918		865	+- 145	LT 209		LT 47	
Micropterus dolomieu	gut	10/10/91	LT 1877		6487	+- 817	LT 178		LT 107	
	gut	Yearly	--		2574	+- 4722	--		--	
Cyprinus carpio	gut	05/21/92	LT 1743		3935	+- 661	LT 159		LT 103	
Cyprinus carpio	gut	10/14/92	LT 2024		4765	+- 667	LT 171		LT 85	
Ictalurus punctatus	gut	10/14/92	LT 1675		LT 100		LT 151		LT 84	
Ictalurus sp.	gut	05/21/92	LT 1931		5798	+- 789	LT 164		LT 90	
M. saxatalis + M. chrysops	gut	10/14/92	LT 723		1257	+- 178	LT 59		LT 39	
Micropterus dolomieu	gut	05/21/92	LT 868		1757	+- 249	LT 71		LT 37	
Micropterus dolomieu	gut	10/14/92	LT 838		1231	+- 212	LT 76		LT 38	
Micropterus salmoides	gut	05/21/92	LT 651		900	+- 149	LT 58		LT 36	
Micropterus salmoides	gut	10/14/92	LT 1867		4331	+- 580	LT 178		LT 92	
	gut	Yearly	--		2997	+- 3833	--		--	
Carpoides cyprinus	gut	05/12/93	LT 17929		1208	+- 193	LT 805		LT 51	
Carpoides cyprinus	gut	09/16/93	LT 3742		2358	+- 325	LT 246		LT 33	
Cyprinus carpio	gut	05/12/93	LT 13473		2815	+- 327	LT 558		LT 30	
Cyprinus carpio	gut	09/16/93	LT 2964		2538	+- 294	LT 178		LT 32	
Ictalurus punctatus	gut	05/12/93	LT 11049		1874	+- 232	LT 512		LT 33	
Ictalurus punctatus	gut	09/16/93	LT 3286		13536	+- 785	LT 210		LT 38	
Micropterus dolomieu	gut	05/12/93	LT 17346		2723	+- 359	LT 733		LT 47	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Be-7 CONC	Be-7 ERR	K-40 CONC	K-40 ERR	Co-58 CONC	Co-58 ERR	Co-60 CONC	Co-60 ERR
Micropterus dolomieu	gut	09/16/93	LT 2439		1114 +-	174	LT 149		LT 30	
Micropterus salmoides	gut	05/12/93	LT 12738		1790 +-	226	LT 485		LT 30	
Micropterus salmoides	gut	09/16/93	LT 4994		1558 +-	240	LT 336		LT 56	
Porosoma cepedianum	gut	05/12/93	LT 10832		2657 +-	303	LT 485		LT 34	
Porosoma cepedianum	gut	09/16/93	LT 3263		2162 +-	285	LT 240		LT 38	
	gut	Yearly	--		3028 +-	6719	--		--	
Carpoides cyprinus	gut	05/10/94	LT 338		1490 +-	128	LT 34		LT 34	
Cyprinus carpio	gut	05/10/94	LT 193		6396 +-	461	LT 22		LT 25	
Cyprinus carpio	gut	09/23/94	LT 236		6332 +-	456	LT 24		LT 24	
Ictalurus punctatus	gut	05/10/94	LT 254		5152 +-	412	LT 29		LT 27	
Micropterus dolomieu	gut	05/10/94	LT 181		4235 +-	322	LT 19		LT 20	
Micropterus dolomieu	gut	09/23/94	LT 223		3286 +-	381	LT 23		LT 23	
Micropterus salmoides	gut	05/10/94	LT 190		4972 +-	368	LT 23		LT 23	
Micropterus salmoides	gut	09/23/94	LT 300		4028 +-	483	LT 36		LT 31	
Porosoma cepedianum	gut	05/10/94	LT 200		1856 +-	130	LT 21		LT 22	
Moxostoma spp.	gut	09/23/94	LT 232		4469 +-	420	LT 24		LT 25	
Stizostedion vitreum	gut	05/10/94	LT 339		319 +-	29	LT 36		LT 34	
	gut	Yearly	--		3867 +-	3924	--		--	
	gut	Overall	--		3116 +-	1083	--		--	
Notropis sp.	whole	07/29/91	LT 68		2584 +-	145	LT 8		LT 11	
Notropis sp.	whole	10/10/91	LT 20		2320 +-	74	LT 2		LT 3	
Porosoma cepedianum	whole	07/29/91	LT 68		1977 +-	111	LT 7		LT 9	
Porosoma cepedianum	whole	10/10/91	LT 78		1686 +-	71	LT 8		6 +-	6
	whole	Yearly	--		2142 +-	785	--		6 +-	6
Lepomis gibbosus	whole	10/14/92	LT 128		3082 +-	228	LT 14		LT 14	
Lepomis macrochirus	whole	05/21/92	LT 82		2538 +-	152	LT 9		LT 9	
Notropis sp.	whole	05/21/92	LT 2004		5995 +-	899	LT 179		LT 153	
Notropis sp.	whole	10/14/92	LT 17		2163 +-	65	LT 2		LT 2	
Porosoma cepedianum	whole	10/14/92	LT 56		2029 +-	81	LT 6		9 +-	5

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

			Be-7		K-40		Co-58		Co-60	
SPECIES	TYPE	DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Porosoma cepedianum	whole	10/14/92	LT 107		3028 +-	109	LT 10		LT 7	
	whole	Yearly	--		3139 +-	2928	--		9 +-	5
Menidia sp.	whole	09/16/93	LT 250		1891 +-	79	LT 18		LT 3	
	whole	Yearly	--		1891 +-	79	--		--	
Menidia sp.	whole	05/10/94	LT 23		1931 +-	58	LT 3		LT 3	
	whole	Yearly	--		1931 +-	58	--		--	
	whole	Overall	--		2276 +-	1172	--		8 +-	4
Station PBSRV010 - Peach Bottom Susquehanna River Station 1										
Ictalurus sp.	flesh	05/23/91	LT 25		3062 +-	98	LT 3		LT 4	
	flesh	Yearly	--		3062 +-	98	--		--	
Carpoides cyprinus	flesh	06/02/92	LT 34		6498 +-	221	LT 4		LT 5	
Cyprinus carpio	flesh	06/02/92	LT 27		2795 +-	95	LT 3		LT 4	
Ictalurus punctatus	flesh	06/02/92	LT 69		3664 +-	183	LT 7		LT 8	
Micropterus dolomieu	flesh	06/02/92	LT 38		3920 +-	141	LT 5		LT 6	
Morone americanus	flesh	06/02/92	LT 55		3321 +-	159	LT 6		LT 6	
Porosoma cepedianum	flesh	06/02/92	LT 50		3115 +-	112	LT 5		LT 6	
	flesh	Yearly	--		3886 +-	2680	--		--	
	flesh	Overall	--		3474 +-	1165	--		--	
Cyprinus carpio	gut	06/02/92	LT 471		1571 +-	217	LT 47		LT 37	
Ictalurus punctatus	gut	06/02/92	LT 3000		1347 +-	148	LT 189		LT 100	
Micropterus dolomieu	gut	06/02/92	LT 461		2237 +-	268	LT 48		LT 38	
Morone americanus	gut	06/02/92	LT 1603		4654 +-	661	LT 143		LT 95	
	gut	Yearly	--		2452 +-	3031	--		--	
	gut	Overall	--		--		--		--	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBLYH010 - Peach Bottom Little Yellow House Station 1												
Carpoides cyprinus	flesh	07/29/91	LT 10		LT 13		LT 18		LT 30		LT 30	
Cyprinus carpio	flesh	07/29/91	LT 2		4	+- 3	LT 4		LT 7		LT 7	
Cyprinus carpio	flesh	10/10/91	LT 2		6	+- 3	LT 5		LT 7		LT 8	
Ictalurus punctatus	flesh	07/29/91	LT 4		7	+- 7	LT 6		LT 11		LT 11	
Ictalurus punctatus	flesh	10/10/91	LT 2		5	+- 3	LT 3		LT 7		LT 6	
M. saxatalis + M. chrysops	flesh	10/10/91	LT 2		5	+- 2	LT 3		LT 6		LT 6	
Micropterus dolomieu	flesh	07/29/91	LT 4		4	+- 6	LT 5		LT 9		LT 8	
Micropterus dolomieu	flesh	10/10/91	LT 9		10	+- 10	LT 17		LT 25		LT 30	
	flesh	Yearly	--		6	+- 4	--		--		--	
Carpoides cyprinus	flesh	05/21/92	LT 10		LT 11		LT 14		LT 26		LT 26	
Carpoides cyprinus	flesh	10/14/92	LT 4		LT 5		LT 6		LT 11		LT 10	
Cyprinus carpio	flesh	05/21/92	LT 5		LT 6		LT 7		LT 15		LT 14	
Cyprinus carpio	flesh	10/14/92	LT 4		LT 4		LT 5		LT 10		LT 9	
Ictalurus punctatus	flesh	10/14/92	LT 4		8	+- 5	LT 10		LT 13		LT 17	
Ictalurus sp.	flesh	05/21/92	LT 10		LT 12		LT 14		LT 27		LT 26	
Lepomis gibbosus	flesh	05/21/92	LT 5		9	+- 6	LT 9		LT 14		LT 15	
M. saxatalis + M. chrysops	flesh	10/14/92	LT 2		5	+- 3	LT 4		LT 7		LT 6	
Micropterus dolomieu	flesh	05/21/92	LT 3		7	+- 4	LT 4		LT 8		LT 7	
Micropterus dolomieu	flesh	10/14/92	LT 3		3	+- 4	LT 4		LT 8		LT 7	
Micropterus salmoides	flesh	05/21/92	LT 5		5	+- 6	LT 7		LT 14		LT 12	
Micropterus salmoides	flesh	10/14/92	LT 2		4	+- 2	LT 3		LT 6		LT 5	
Porosoma cepedianum	flesh	05/21/92	LT 5		7	+- 4	LT 7		LT 13		LT 12	
	flesh	Yearly	--		6	+- 4	--		--		--	
Carpoides cyprinus	flesh	05/12/93	LT 9		LT 8		LT 232		LT 47		LT 425	
Carpoides cyprinus	flesh	09/16/93	LT 3		3	+- 3	LT 24		LT 11		LT 51	
Cyprinus carpio	flesh	05/12/93	LT 2		2	+- 3	LT 6		LT 7		LT 12	
Cyprinus carpio	flesh	09/16/93	LT 4		LT 5		LT 26		LT 16		LT 48	
Ictalurus punctatus	flesh	05/12/93	LT 3		13	+- 5	LT 83		LT 20		LT 179	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Ictalurus punctatus	flesh	09/16/93	LT 6		2 +-	5	LT 50		LT 23		LT 91	
Lepomis gibbosus	flesh	05/12/93	LT 9		LT 9		LT 237		LT 46		LT 421	
Lepomis macrochirus	flesh	05/12/93	LT 10		LT 9		LT 214		LT 45		LT 447	
Micropterus dolomieu	flesh	05/12/93	LT 7		10 +-	8	LT 179		LT 38		LT 417	
Micropterus dolomieu	flesh	09/16/93	LT 2		1 +-	1	LT 15		LT 8		LT 32	
Micropterus salmoides	flesh	05/12/93	LT 3		4 +-	4	LT 8		LT 10		LT 17	
Micropterus salmoides	flesh	09/16/93	LT 2		LT 3		LT 19		LT 10		LT 33	
Notropis sp.	flesh	05/12/93	LT 12		LT 11		LT 269		LT 55		LT 492	
Pomoxis sp.	flesh	05/12/93	LT 11		5 +-	10	LT 289		LT 55		LT 516	
Porosoma cepedianum	flesh	05/12/93	LT 5		LT 5		LT 169		LT 23		LT 267	
Porosoma cepedianum	flesh	09/16/93	LT 6		LT 6		LT 51		LT 23		LT 81	
Porosoma cepedianum	flesh	09/16/93	LT 3		16 +-	4	LT 32		LT 15		LT 53	
Moxostoma spp.	flesh	05/12/93	LT 7		LT 6		LT 193		LT 42		LT 331	
Moxostoma spp.	flesh	09/16/93	LT 6		LT 6		LT 50		LT 21		LT 73	
Lepomis spp.	flesh	09/16/93	LT 10		LT 10		LT 92		LT 39		LT 167	
	flesh	Yearly	--		6 +-	11	--		--		--	
Carpoides cyprinus	flesh	05/10/94	LT 5		3 +-	4	LT 6		LT 12		LT 10	
Cyprinus carpio	flesh	05/10/94	LT 1		LT 2		LT 2		LT 4		LT 3	
Cyprinus carpio	flesh	09/23/94	LT 2		5 +-	3	LT 3		8 +-	7	LT 5	
Ictalurus punctatus	flesh	05/10/94	LT 3		5 +-	3	LT 3		LT 7		LT 5	
Micropterus dolomieu	flesh	05/10/94	LT 2		4 +-	2	LT 3		LT 6		LT 5	
Micropterus dolomieu	flesh	09/23/94	LT 2		3 +-	3	LT 3		LT 7		LT 5	
Micropterus salmoides	flesh	05/10/94	LT 2		3 +-	2	LT 2		LT 5		LT 4	
Micropterus salmoides	flesh	09/23/94	LT 2		2 +-	2	LT 2		LT 5		LT 4	
Porosoma cepedianum	flesh	05/10/94	LT 2		3 +-	3	LT 3		LT 7		LT 6	
Porosoma cepedianum	flesh	09/23/94	LT 2		5 +-	3	LT 3		20 +-	9	LT 6	
Moxostoma spp.	flesh	09/23/94	LT 3		3 +-	3	LT 4		11 +-	8	LT 6	
Stizostedion vitreum	flesh	05/10/94	LT 4		6 +-	4	LT 5		LT 10		LT 8	
Lepomis spp.	flesh	05/10/94	LT 4		3 +-	4	LT 5		LT 11		LT 9	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Lepomis spp.	flesh	09/23/94	LT 2		1	+- 2	LT 3		24	+- 6	LT 4	
	flesh	Yearly	--		4	+- 3	--		16	+- 15	--	
	flesh	Overall	--		5	+- 3	--		16	+- 15	--	
Carpoides cyprinus	gut	07/29/91	LT 106		LT 127		LT 180		LT 318		LT 334	
Cyprinus carpio	gut	07/29/91	LT 26		96	+- 47	LT 48		LT 78		LT 82	
Cyprinus carpio	gut	10/10/91	LT 71		LT 64		LT 747		LT 244		LT 1266	
Ictalurus punctatus	gut	07/29/91	LT 32		LT 32		LT 157		LT 97		LT 277	
Ictalurus punctatus	gut	10/10/91	LT 67		LT 71		LT 177		LT 172		LT 297	
M. saxatalis + M. chrysops	gut	10/10/91	LT 29		LT 29		LT 320		LT 98		LT 583	
Micropterus dolomieu	gut	07/29/91	LT 39		LT 42		LT 261		LT 131		LT 414	
Micropterus dolomieu	gut	10/10/91	LT 112		LT 113		LT 190		LT 265		LT 331	
	gut	Yearly	--		96	+- 47	--		--		--	
Cyprinus carpio	gut	05/21/92	LT 99		LT 103		LT 171		LT 222		LT 307	
Cyprinus carpio	gut	10/14/92	LT 76		LT 84		LT 175		LT 217		LT 334	
Ictalurus punctatus	gut	10/14/92	LT 71		LT 79		LT 169		LT 202		LT 296	
Ictalurus sp.	gut	05/21/92	LT 93		LT 104		LT 185		LT 237		LT 334	
M. saxatalis + M. chrysops	gut	10/14/92	LT 30		LT 35		LT 66		LT 85		LT 129	
Micropterus dolomieu	gut	05/21/92	LT 31		LT 31		LT 77		LT 78		LT 147	
Micropterus dolomieu	gut	10/14/92	LT 32		LT 37		LT 85		LT 93		LT 136	
Micropterus salmoides	gut	05/21/92	LT 33		LT 35		LT 65		LT 83		LT 110	
Micropterus salmoides	gut	10/14/92	LT 82		LT 84		LT 185		LT 227		LT 309	
	gut	Yearly	--		--		--		--		--	
Carpoides cyprinus	gut	05/12/93	LT 45		LT 41		LT 1073		LT 201		LT 2404	
Carpoides cyprinus	gut	09/16/93	LT 34		LT 35		LT 285		LT 130		LT 666	
Cyprinus carpio	gut	05/12/93	LT 30		LT 27		LT 747		LT 153		LT 1350	
Cyprinus carpio	gut	09/16/93	LT 27		LT 26		LT 223		LT 91		LT 401	
Ictalurus punctatus	gut	05/12/93	LT 31		LT 27		LT 601		LT 135		LT 1420	
Ictalurus punctatus	gut	09/16/93	LT 28		LT 29		LT 255		LT 118		LT 462	
Micropterus dolomieu	gut	05/12/93	LT 44		LT 40		LT 1134		LT 184		LT 1800	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

SPECIES	TYPE	DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Micropterus dolomieu	gut	09/16/93	LT 26		LT 24		LT 208		LT 93		LT 431	
Micropterus salmoides	gut	05/12/93	LT 29		LT 27		LT 720		LT 140		LT 1282	
Micropterus salmoides	gut	09/16/93	LT 45		LT 51		LT 346		LT 154		LT 618	
Porosoma cepedianum	gut	05/12/93	LT 29		LT 27		LT 646		LT 135		LT 1232	
Porosoma cepedianum	gut	09/16/93	LT 31		LT 30		LT 282		LT 118		LT 495	
	gut	Yearly	--		--		--		--		--	
Carpoides cyprinus	gut	05/10/94	LT 29		LT 34		LT 37		LT 65		LT 66	
Cyprinus carpio	gut	05/10/94	LT 20		LT 23		LT 22		LT 46		LT 38	
Cyprinus carpio	gut	09/23/94	LT 19		LT 23		LT 26		LT 51		LT 46	
Ictalurus punctatus	gut	05/10/94	LT 24		LT 30		LT 30		LT 72		LT 53	
Micropterus dolomieu	gut	05/10/94	LT 18		LT 22		LT 21		LT 46		LT 37	
Micropterus dolomieu	gut	09/23/94	LT 17		LT 21		LT 25		LT 45		LT 44	
Micropterus salmoides	gut	05/10/94	LT 21		LT 23		LT 24		LT 48		LT 49	
Micropterus salmoides	gut	09/23/94	LT 24		LT 28		LT 37		LT 64		LT 59	
Porosoma cepedianum	gut	05/10/94	LT 19		LT 21		LT 23		LT 41		LT 41	
Moxostoma spp.	gut	09/23/94	LT 18		LT 22		LT 25		LT 56		LT 43	
Stizostedion vitreum	gut	05/10/94	LT 30		LT 34		LT 39		LT 54		LT 86	
	gut	Yearly	--		--		--		--		--	
	gut	Overall	--		96	+- 47	--		--		--	
Notropis sp.	whole	07/29/91	LT 7		LT 9		LT 8		LT 20		LT 14	
Notropis sp.	whole	10/10/91	LT 2		2	+- 3	LT 2		LT 6		LT 4	
Porosoma cepedianum	whole	07/29/91	LT 7		LT 9		LT 8		LT 18		LT 14	
Porosoma cepedianum	whole	10/10/91	LT 6		25	+- 9	LT 9		LT 16		LT 15	
	whole	Yearly	--		14	+- 33	--		--		--	
Lepomis gibbosus	whole	10/14/92	LT 13		LT 14		LT 14		LT 31		LT 25	
Lepomis macrochirus	whole	05/21/92	LT 6		LT 8		LT 9		LT 17		LT 17	
Notropis sp.	whole	05/21/92	LT 146		LT 157		LT 192		LT 339		LT 364	
Notropis sp.	whole	10/14/92	LT 1		3	+- 2	LT 2		LT 5		LT 3	
Porosoma cepedianum	whole	10/14/92	LT 2		6	+- 4	LT 6		LT 8		LT 10	

Table 2. Radionuclide Concentrations in Fish (pCi/kg +- 2 sigma error)

			Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
SPECIES	TYPE	DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
Porosoma cepedianum	whole	10/14/92	LT 5		14	+- 5	LT 11		LT 14		LT 20	
	whole	Yearly	--		8	+- 11	--		--		--	
Menidia sp.	whole	09/16/93	LT 2		LT 3		LT 21		LT 11		LT 37	
	whole	Yearly	--		--		--		--		--	
Menidia sp.	whole	05/10/94	LT 2		LT 2		LT 3		LT 5		LT 4	
	whole	Yearly	--		--		--		--		--	
	whole	Overall	--		11	+- 8	--		--		--	
Station PBSRV010 - Peach Bottom Susquehanna River Station 1												
Ictalurus sp.	flesh	05/23/91	LT 2		6	+- 4	LT 3		LT 7		LT 5	
	flesh	Yearly	--		6	+- 4	--		--		--	
Carpoides cyprinus	flesh	06/02/92	LT 3		6	+- 4	LT 4		LT 9		LT 7	
Cyprinus carpio	flesh	06/02/92	LT 2		LT 3		LT 3		LT 7		LT 6	
Ictalurus punctatus	flesh	06/02/92	LT 6		7	+- 7	LT 8		LT 16		LT 14	
Micropterus dolomieu	flesh	06/02/92	LT 3		10	+- 5	LT 5		LT 10		LT 9	
Morone americanus	flesh	06/02/92	LT 5		9	+- 6	LT 7		LT 14		LT 11	
Porosoma cepedianum	flesh	06/02/92	LT 4		LT 5		LT 6		LT 12		LT 10	
	flesh	Yearly	--		8	+- 4	--		--		--	
	flesh	Overall	--		7	+- 3	--		--		--	
Cyprinus carpio	gut	06/02/92	LT 27		LT 29		LT 48		LT 79		LT 80	
Ictalurus punctatus	gut	06/02/92	LT 97		LT 94		LT 206		LT 245		LT 392	
Micropterus dolomieu	gut	06/02/92	LT 30		LT 33		LT 56		LT 74		LT 83	
Morone americanus	gut	06/02/92	LT 93		LT 102		LT 149		LT 218		LT 264	
	gut	Yearly	--		--		--		--		--	
	gut	Overall	--		--		--		--		--	

Table 3. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg +- 2 sigma error)

		Be-7		K-40		Co-58		Co-60	
SPECIES	DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
		Station PBSRV010 - Peach Bottom Susquehanna River Station 1							
Myriophyllum spicatum	07/29/91	189 +-	39	1572 +-	69	LT 3		LT 4	
Myriophyllum spicatum	10/10/91	113 +-	31	690 +-	51	LT 2		LT 3	
Myriophyllum spicatum	Yearly	151 +-	107	1131 +-	1247	--		--	
Myriophyllum spicatum	10/14/92	42 +-	27	503 +-	38	LT 2		LT 3	
Myriophyllum spicatum	Yearly	42 +-	27	503 +-	38	--		--	
Myriophyllum spicatum	09/16/93	618 +-	469	1121 +-	61	LT 22		LT 4	
Myriophyllum spicatum	Yearly	618 +-	469	1121 +-	61	--		--	
Myriophyllum spicatum	09/23/94	93 +-	53	2191 +-	88	LT 4		LT 4	
Myriophyllum spicatum	Yearly	93 +-	53	2191 +-	88	--		--	
Myriophyllum spicatum	Overall	226 +-	530	1237 +-	1402	--		--	
		Station PBSRV030 - Peach Bottom Susquehanna River Station 3							
Myriophyllum spicatum	06/11/92	101 +-	31	1102 +-	55	LT 2		LT 3	
Myriophyllum spicatum	Yearly	101 +-	31	1102 +-	55	--		--	
Myriophyllum spicatum	Overall	101 +-	31	1102 +-	55	--		--	
		Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1							
Myriophyllum spicatum	05/11/93	65 +-	58	1197 +-	69	LT 5		LT 4	
Myriophyllum spicatum	Yearly	65 +-	58	1197 +-	69	--		--	
Myriophyllum spicatum	Overall	65 +-	58	1197 +-	69	--		--	

Table 3. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg +- 2 sigma error)

SPECIES	DATE	Be-7 CONC	Be-7 ERR	K-40 CONC	K-40 ERR	Co-58 CONC	Co-58 ERR	Co-60 CONC	Co-60 ERR
		Station PBSFL070 - Peach Bottom Susquehanna Flats Station 7							
Myriophyllum spicatum	10/10/91	110 +-	81	1413 +-	99	LT 9		LT 9	
Myriophyllum spicatum	Yearly	110 +-	81	1413 +-	99	--		--	
Myriophyllum spicatum	06/11/92	121 +-	65	1799 +-	108	LT 7		LT 8	
Myriophyllum spicatum	10/14/92	73 +-	97	1565 +-	116	LT 9		LT 10	
Myriophyllum spicatum	Yearly	97 +-	68	1682 +-	331	--		--	
Myriophyllum spicatum	09/16/93	LT 504		1722 +-	79	LT 25		LT 5	
Myriophyllum spicatum	Yearly	--		1722 +-	79	--		--	
Myriophyllum spicatum	Overall	104 +-	18	1606 +-	336	--		--	

Table 3. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg +- 2 sigma error)

SPECIES	DATE	Cs-134 CONC	Cs-134 ERR	Cs-137 CONC	Cs-137 ERR	Nb-95 CONC	Nb-95 ERR	Zn-65 CONC	Zn-65 ERR	Zr-95 CONC	Zr-95 ERR
Station PBSRV010 - Peach Bottom Susquehanna River Station 1											
Myriophyllum spicatum	07/29/91	LT 3		LT 3		LT 3		LT 7		LT 5	
Myriophyllum spicatum	10/10/91	LT 2		LT 3		LT 3		LT 5		LT 5	
Myriophyllum spicatum	Yearly	--		--		--		--		--	
Myriophyllum spicatum	10/14/92	LT 2		4 +-	2	LT 3		LT 5		LT 4	
Myriophyllum spicatum	Yearly	--		4 +-	2	--		--		--	
Myriophyllum spicatum	09/16/93	LT 3		3 +-	3	LT 30		LT 13		LT 58	
Myriophyllum spicatum	Yearly	--		3 +-	3	--		--		--	
Myriophyllum spicatum	09/23/94	LT 3		LT 4		LT 5		5 +-	7	LT 8	
Myriophyllum spicatum	Yearly	--		--		--		5 +-	7	--	
Myriophyllum spicatum	Overall	--		4 +-	1	--		5 +-	7	--	
Station PBSRV030 - Peach Bottom Susquehanna River Station 3											
Myriophyllum spicatum	06/11/92	LT 2		3 +-	3	LT 3		LT 5		LT 5	
Myriophyllum spicatum	Yearly	--		3 +-	3	--		--		--	
Myriophyllum spicatum	Overall	--		3 +-	3	--		--		--	
Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1											
Myriophyllum spicatum	05/11/93	LT 3		5 +-	4	LT 6		LT 8		LT 10	
Myriophyllum spicatum	Yearly	--		5 +-	4	--		--		--	
Myriophyllum spicatum	Overall	--		5 +-	4	--		--		--	

Table 3. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg +- 2 sigma error)

		Cs-134		Cs-137		Nb-95		Zn-65		Zr-95	
SPECIES	DATE	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR	CONC	ERR
		Station PBSFL070 - Peach Bottom Susquehanna Flats Station 7									
Myriophyllum spicatum	10/10/91	LT 8		LT 11		LT 10		LT 19		LT 16	
Myriophyllum spicatum	Yearly	--		--		--		--		--	
Myriophyllum spicatum	06/11/92	LT 8		8 +-	7	LT 8		LT 17		LT 14	
Myriophyllum spicatum	10/14/92	LT 11		LT 11		LT 6		LT 23		LT 17	
Myriophyllum spicatum	Yearly	--		8 +-	7	--		--		--	
Myriophyllum spicatum	09/16/93	LT 4		8 +-	4	LT 37		LT 12		LT 116	
Myriophyllum spicatum	Yearly	--		8 +-	4	--		--		--	
Myriophyllum spicatum	Overall	--		8 +-	0	--		--		--	